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ABSTRACT

Biological Science Grade 7, a one semester course in the Los Angeles Unified School District, provides students with opportunities for a comprehensive study of living organisms using an investigative approach. This course outline is designed to assist teachers in planning and implementing daily and weekly lessons and in meeting course objectives. Contents include: (1) summary of representative objectives; (2) teacher responsibilities; (3) schedule of class activities; (4) guidelines for assignment of homework; (5) how to use this outline; (6) time schedule and sequence of units; (7) required skills and concepts (containing the objectives, content outlines, and continuum skills for nine units of study); (8) lesson planning (providing nine sample lessons with activities); (9) teaching strategies; (10) major categories of thinking and some verbs for use in stating cognitive outcomes; (11) evaluation procedures; and (12) tips for parents. Appendices consist of a list of resources and the secondary science continuum for the Los Angeles Unified School District. (ML)

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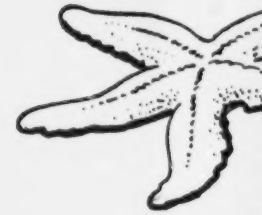
BIOLOGICAL SCIENCE
GRADE 7

An Instructional Course Outline



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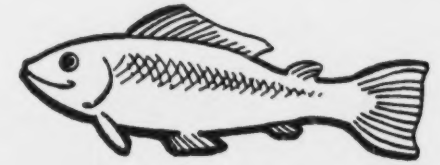

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Publication No. SC-862

BIOLOGICAL SCIENCE GRADE 7

AN INSTRUCTIONAL COURSE OUTLINE

LOS ANGELES UNIFIED SCHOOL DISTRICT

OFFICE OF INSTRUCTION PUBLICATION NO. SC-862 1984

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FOREWORD

Biological Science 7 provides students with opportunities for a comprehensive study of living organisms, using an investigative approach. Through direct involvement in science processes and familiarity with important concepts, the students develop an awareness of relationships between organisms and gain important knowledge concerning their structure, function, behavior, and relationships with the environment. This course meets one semester of the District junior high school requirement for science. The remainder of the junior high school course requirements is met by Introductory Physical and Earth Science 8AB.

Science is the discipline through which people acquire and organize knowledge to explain natural phenomena. Through the science instructional program in secondary schools, students develop an understanding that science is a body of knowledge comprised of interconnected sets of principles, laws, and theories that explain the known universe and our relationship to it. Students investigate phenomena systematically and acquire and refine information.

The emphasis of this course is to assist students in developing the knowledge and skills necessary for leading successful and productive lives in a technological society. The course outline includes a unit on the development of relevant skills, sample lesson plans, content, and objectives.

For science to be a dynamic factor in the lives of students, instruction must be both relevant and appropriate to their development level. In the publication are descriptions of laboratory investigations and other activities to motivate individual development of skills in critical thinking, decision making, and problem solving. Outcomes include understanding how humans use scientific information and discoveries essential for analyzing and comprehending one's environment and for developing approaches to the problems of daily living.

This Biological Science 7 Instructional Course Outline should be used in conjunction with the Secondary Science Skills Continuum and the Guidelines for Instruction, Science (Publication No. SC-769.19, 1984). This publication will assist teachers in planning and implementing daily and weekly lessons and units of instruction, as well as in the achievement of course objectives.

ACKNOWLEDGMENTS

Many persons contributed to the development of this instructional outline. Gratitude is expressed to those individuals who reviewed the content, suggested changes in the course descriptions and objectives, and recommended unit titles and concepts.

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SUMMARY OF REPRESENTATIVE OBJECTIVES

UNIT TITLE	OBJECTIVES
SKILLS AND CONCEPTS REQUIRED AND DEVELOPED IN BIOLOGICAL SCIENCE 7	- Assemble and use laboratory apparatus, tools, and materials in a skillful manner, giving due attention to safety measures. - Provide an environment for plant and animal life that is conducive to the support of normal life functions. - Develop ability to generate data by observing, recalling, recognizing, identifying, and measuring. - Prepare a laboratory report.
Unit One INTRODUCTION TO BIOLOGICAL SCIENCE	- Show curiosity about objects and events. - Record observations accurately and organize data and ideas in ways that improve their usefulness. - Demonstrate knowledge of the processes of scientific inquiry. - Use the metric system effectively. - Assemble and use laboratory apparatus, tools, and materials in a skillful manner, giving due attention to safety measures.

UNIT TITLE	OBJECTIVES
Unit Two	
WHAT ARE LIVING THINGS?	- Recognize that all living things have the same life processes. - Appreciate and respect all living organisms, including self and his/her relationship to the environment. - Understand and describe living organisms that grow and develop in different environments.
Unit Three	
THE CELL	- Identify the cell as the unit of structure and function in all living things. - Compare and contrast animal and plant cells. - Use appropriate laboratory tools and techniques for observing cells in a safe manner.
Unit Four	
CLASSIFICATION OF LIVING THINGS	- Describe systems of classification used to sort groups of objects. - Demonstrate the use of a classification system based on observable characteristics. - List the seven steps in the modern binomial system of taxonomy.

UNIT TITLE	OBJECTIVES
Unit Five	
PROTISTS	- Describe the characteristics of Kingdom Protista. - Recognize that all living organisms have the same life processes. - List the harmful and beneficial effects of protista. - Compare and contrast viruses, bacteria, and protozoans.
Unit Six	
PLANTS	- List the characteristics of plants. - Compare and contrast algae, fungi, nonvascular, and vascular plants. - Recognize that the sun is the source of energy for green plants. - Examines the importance of the seed and flower.
Unit Seven	
ANIMALS	- Describe the characteristics of animals. - Maintain animals for safe laboratory use. - Demonstrate the use of a classification system based on observable characteristics. - Describe the major organ systems in animals.

UNIT TITLE	OBJECTIVES
Unit Eight	
HEREDITY	- Identify dominant and recessive traits. - Recognize the gene as the unit of inheritance. - Recognize that all living organisms have the same life processes. - Identify genetic engineering as a growing research endeavor.
Unit Nine	
ECOLOGY AND CONSERVATION	- Appreciate the interdependence of living organisms in the natural environment and the implications for continued survival. - Describe major biomes. - Recognize the importance of energy levels as related to ecosystems. - Recognize the value of using renewable energy sources instead of nonrenewable sources. - Explain the effects of pollution on the environment.

TEACHER RESPONSIBILITIES

The teacher is responsible for creating, maintaining, and fostering a classroom environment and climate that encourages instructional excellence and achievement. To establish and maintain such an environment, the teacher is responsible for:

1. Providing students and parents with a clear statement of instructional objectives, overall goals, and standards of expected progress and achievement.

2. Providing instruction which incorporates a diagnostic-prescriptive program for learning all required skills and concepts.

3. Following the timeline as closely as possible, preparing instructional activities for the entire class period, and assisting students in striving for mastery of content and process skills.

4. Having evidence in the classroom of lesson planning to meet the educational needs of the students and the goals of the instructional program.

5. Providing regular instruction and practice in preparing students to perform successfully on tests and other measures of achievement.

6. Maintaining well-defined and consistent classroom standards for academic achievement, citizenship, and work habits.

7. Providing regularly assigned homework designed to reinforce classroom instruction.

8. Providing students and parents with an explanation of the standards used for assigning marks.

9. Providing prompt feedback to students on the results of quizzes, homework, and other class assignments.

10. Recording in the rollbook a minimum of one grade per week for each student.

11. Recognizing individual student progress and exceptional achievements; displaying examples of student accomplishments and products in the classroom.

12. Keeping parents regularly informed of the educational progress and achievement of the student.

13. Informing parents of outstanding progress and accomplishment.

14. Notifying parents of any signs of significant academic decline in student effort or achievement.

15. Providing parents with suggestions on how to help the student study and complete homework assignments.

16. Inviting administrators, department chairpersons, and teacher colleagues to visit the classroom and participate in a sharing of effective and innovative lessons.

THE AGENDA

An agenda, or schedule of class activities, prominently displayed in the classroom, gives immediate directions to the students and prepares them for the day's classwork. The agenda should include an objective, a dispatch activity, scheduled class activities, and homework assignment. The agenda may be written on the chalkboard. Some teachers, particularly teachers who travel from classroom to classroom, prefer to use chart paper that can be easily taped or pinned to a board and quickly removed to be used in a new location. A good way to evaluate an agenda is to ask the question "If a student were absent, could he or she read the agenda and know what happened in the classroom today?"

The dispatch activity is an essential part of the agenda. It should be a short, written, timed exercise that students start as soon as the period begins. Students should be able to complete the dispatch without teacher assistance. The dispatch is used to:

- review and reinforce concepts and ideas previously studied
- start students working immediately upon arrival in class
- preview or introduce new work
- establish a routine
- allow the teacher an opportunity to take care of attendance responsibilities

Below is a sample agenda as it should be written on the board.

AGENDA

Teacher's Name
Biological Science 7, Period 1
September, 1984

Objective:	To recognize the differences between living and non-living things.
Dispatch:	Draw a line down the center of your paper. On the left side write a list of living things and on the right side a list of non-living things around your home.

Class work:	Discussion and observation of living and non-living things.
Independent work:	Write additional things on the lists started in the dispatch including those observed in class.
Homework:	Write a paragraph listing the characteristics of the living things and non-living things on the lists.
Summary:	Summarize characteristics of living and non-living things.

GUIDELINES FOR ASSIGNMENT OF HOMEWORK

These guidelines should be considered when planning homework assignments:

1. Homework is an important resource for teachers in helping students to learn.
2. Homework may be scheduled, when appropriate, over an extended period of time, which may include weekends.
3. Homework assignments should be reasonable in length, content, and required resources.
4. Homework should be assigned to reinforce, extend, and enrich learning.
5. Homework assignments should be related to course objectives.
6. Homework assignments and due dates should be thoroughly explained by the teacher and understood by the student.
7. Once homework has been assigned, it becomes the responsibility of the student to learn the content, process, and due date and to complete the assignment as required.
8. Completed homework assignments should be acknowledged and/or evaluated by the teacher and reviewed with students.

Parents and guardians should be informed of homework schedules, including dates given and time allowance. They should also understand the level of independent work expected of the student and the parental help and involvement required.

HOW TO USE THIS OUTLINE

This outline was designed to assist the teacher. It includes a summary of representative objectives, a time schedule, and a sequence for each unit. The introductory section on skills and concepts is not designed to be taught separately but is to be included throughout the course as each unit is studied. The skills and concepts in the introductory section are those which are to be developed as needed for maximum relevance to the student laboratory activities. Included are safe laboratory practices, use and care of living organisms, proper care of laboratory equipment, use of the scientific method, preparing graphs, and necessary library and research skills.

The nine units are divided into suggested content areas. The content of each area is correlated. with the skills continuum which begins on page 96, with the skills to be developed in this course, and with sample teacher-directed lessons. The sample lessons for the seven units are developed in accordance with the Quality Skills Building (QSB) model. This model has been selected because the students will find the results of the lessons to be more effective and enjoyable.

By developing a lesson in this format, the teacher will be able to clarify outcomes, values to students, and strategy. Planning and preparation of worksheets and study guides for students are encouraged. The guides and worksheets should be designed for use in both the regular and alternative lessons and for high- or low-ability students.

In the teaching strategies section is presented a variety of teaching methodologies to provide for different learning modalities.

In the evaluation section, the teacher will find suggestions and descriptions of different methods of testing. By using the QSB model, the teacher can clarify objectives in order to expedite testing.

Tips for parents are designed to assist teachers in obtaining parental support. Copies of these tips may be distributed to students to help stimulate parent involvement.

The appendices include titles of District publications and the skills continuum. The continuum should be used to identify representative goals and objectives for students in the strands of attitudes, skills, thinking processes, and knowlege. The continuum may also be used to teach and reinforce these goals and objectives.

TIME SCHEDULE AND SEQUENCE OF UNITS

UNIT	TOPICS	WEEKS
ONE	INTRODUCTION TO BIOLOGICAL SCIENCE	5
TWO	WHAT ARE LIVING THINGS?	1
THREE	THE CELL	2
FOUR	THE CLASSIFICATION OF LIVING THINGS	1
FIVE	PROTISTS	1
SIX	PLANTS	3
SEVEN	ANIMALS	4
EIGHT	HEREDITY	1
NINE	ECOLOGY AND CONSERVATION	2

SKILLS AND CONCEPTS REQUIRED AND DEVELOPED IN BIOLOGICAL SCIENCE 7

Representative Objectives for This Section

- Assemble and use laboratory apparatus, tools, and materials in a skillful manner, giving due attention to safety measures.
- Provide an environment for plant and animal life that is conducive to the support of normal life functions.
- Develop ability to generate data by observing, recalling, recognizing, identifying, and measuring.
- Prepare a laboratory report.

Content

I. Safe, careful, and responsible laboratory practices are essential for instruction in science.

A. General Laboratory Safety

1. Order and cleaniness are essential for maintaining safe laboratory conditions.
2. Students should not be allowed to perform any experiment without a teacher's direct supervision.
3. Safety instructions should be thoroughly reviewed before attempting any experiment.
4. Constant supervision of student activities is essential in the laboratory.

Continuum Skills

3.1.0 Assembles and uses laboratory apparatus, tools and materials in a skillful manner, giving due attention to safety measures.

3.1.1 Manipulates simple materials, apparatus, and equipment in a safe manner.

3.1.3 Acquires and assembles appropriate science apparatus, materials, and equipment in order to obtain designated data.

5. Every laboratory should have two unobstructed exit doors.

6. Fire extinguishers and fire blankets should be operable and visible.

7. Bunsen burners pose a safety hazard when a student has long hair or wears loose clothing.

8. Safety goggles should be worn when any experiment is conducted which calls for heating, pouring, or mixing chemicals or when any other activity is performed that involves use of materials potentially harmful to the eyes.

9. Chemical substances should never be tasted nor inhaled.

10. Rubber gloves should be used whenever poisonous substances are handled.

11. Care should be taken when handling hot objects. Tongs or gloves should be used.

12. Teachers should make certain that bunsen burners or hot plates are turned off after each class.

13. Master cutoff valves are advisable in laboratories supplied with gas or water.

14. Immature behavior or horseplay should not be permitted in the laboratory.

15. Teachers should make frequent safety inspections of the laboratory.

Content	Continuum Skills
B. Use and Care of Laboratory Animals and Plants	
1. Laboratory animals should be cared for properly.	3.2.0 Demonstrates proper techniques for handling and caring for living organisms.
2. Aquaria and animal cages should be cleaned regularly.	3.2.1 Handles plants and animals carefully, following suggested procedures.
3. Animals should be fed and watered following a definite schedule.	1.3.1 Accepts responsibility for the care of living organisms in natural and artificial environments.
4. Holiday, weekend, or vacation care of plants and animals should be planned in advance.	3.2.2 Provides an environment for plant and animal life that is conducive to the support of normal life functions.
5. Animal or plant specimen bottles should never be opened.	
6. Animal specimens preserved in formaldehyde or formalin should be washed thoroughly before being handled.	
7. Petri dishes containing bacteria or molds should be taped securely and disposed of properly.	
C. Proper Care of Laboratory Equipment	
1. Microscopes are expensive and delicate instruments, and should be handled with care.	3.1.1 Manipulates simple materials, apparatus, and equipment in a safe manner.
a. Students should be instructed always to carry a microscope upright with two hands, one hand holding the arm and one hand supporting the base.	3.1.2 Demonstrates growth in the ability to manipulate more complex science materials and equipment.

Content	Continuum Skills
b. Microscopes should be stored with the low-power objective lens in position.	3.1.3 Acquires and assembles appropriate science apparatus, materials, and equipment in order to obtain designated data.
c. Students should be instructed not to allow direct sunlight to reflect from the mirror into their eyes.	
d. Microscopes should be stored in a cabinet or covered with a plastic cover to protect them from dust.	
e. Microscope lenses should be cleaned only with lens paper.	
f. Microscope oculars should never be removed.	
g. Care should be taken when switching from low to high power.	
2. Beam balances are very delicate instruments.	
a. Beam balances should never be "over-loaded." (The maximum capacity is 210 grams.)	3.7.1 Counts, uses numbers, and balances objects on an equal arm balance scale.
b. Beam balance pans should be cleaned properly and regularly.	3.7.3 Uses a balance to determine the mass of objects.
c. Beam balances should be carried with both hands supporting the base.	
d. Beam balances should be stored in cabinets.	

Content	Continuum Skills
3. Glassware (flasks, beakers, etc.) must be used carefully to avoid breakage, spilled chemicals, and possible injury to students.	3.1.1 Manipulates simple materials, apparatus, and equipment in a safe manner.
4. All laboratory equipment should be used only with teacher supervison.	3.1.2 Demonstrates growth in the ability to manipulate more complex science materials and equipment.
5. All laboratory equipment should be stored and locked in cabinets.	
II. Accurate qualitative and quantitative data are important sources of science information.	
A. The scientific method should be used in writing lab reports. (see Unit One.)	2.1.0 Develops ability to generate data by observing, recalling, recognizing, identifying, and measuring.
1. Laboratory reports should include:	2.2.0 Develops ability to organize data by comparing, classifying, relating, and ordering.
a. Title of experiment	3.6.2 Explains, either orally or in writing, the methods and procedures involved in carrying out an investigation.
b. Equipment or material used	2.3.0 Develops ability to apply and evaluate data and to generate theories by hypothesizing, predicting, inferring, generalizing, theorizing, explaining, justifying, judging, and interpreting.
c. The problem	2.3.2 Gathers own data to form own point of view, satisfying any former contradictions.
d. A list of procedures	2.4.0 Participates in scientific inquiry at the appropriate level.
e. Observations	
f. Results obtained from observations	
g. The conclusion	
2. Recording and reporting data are very essential to scientific inquiry.	

Content	Continuum Skills
	2.4.2 Identifies data needed to test a hypothesis; designs an experiment to generate the data; records and organizes data; and evaluates the hypothesis in light of new data.
B. Preparing a graph is a very important method of displaying data collected in scientific experiments. Students should be instructed in the importance of recording on graphs the results of experiments and shown how to prepare graphs.	3.5.2 Tabulates information and uses tables. 3.5.3 Interprets graphs and displays data graphically.
III. Library and research skills are necessary for investigating topics of scientific interest.	
A. Students should be encouraged to use science texts and encyclopedias.	3.4.0 Gathers needed information, which has been generated by others, from a variety of sources appropriate to his/her ability level.
B. Students should be instructed in how to use the Reader's Guide to Periodicals.	3.4.2 Gathers information from science textbooks, reference materials, science films, and television.
C. Students should be acquainted with the Dewey Decimal System and especially where science books can be located.	3.4.3 Finds sources of information needed to solve a problem related to a specific topic.
D. Students should be encouraged to use recent scientific journals, periodicals, and newspapers.	

UNIT ONE: INTRODUCTION TO BIOLOGICAL SCIENCE

FIVE WEEKS

Representative Objectives for This Unit

- Show curiosity about objects and events.
- Record observations accurately and organize data and ideas in ways that improve their usefulness.
- Demonstrate knowledge of the processes of scientific inquiry.
- Use the metric system effectively.
- Assemble and use laboratory apparatus, tools, and materials in a skillful manner, giving due attention to safety measures.

Content

I. What is science? Science is a way to answer questions and to solve problems.

A. Scientific information comes from many different sources:

1. Reference to authority: Scientific laws, theories, and facts gathered and recorded in the past form a body of scientific knowledge.

2. Trial and Error: Trial and error methods suggest to the scientist ideas that may be tested by controlled experiments and research.

Continuum Skills

1.1.0 Shows curiousity about objects and events.

(Skills - III): Library and research skills are necessary for investigating topics of scientific interest.

1.5.2 Examines a variety of alternative viewpoints on scientific issues to form opinions about them.

3.6.2 Explains, either orally or in writing, the methods and procedures involved in carrying out an investigation.

(Skills - II): Accurate qualitative and quantitative data are important sources of scientific information.

Content	Continuum Skills
3. Experimentation: Experimentation is used to collect data and test hypothesis.	(Skills - IIB): Preparation of graphs is a very important method of displaying scientific experiments.
4. Scientific methods: Scientific methods involve use of a series of steps which suggest ways of collecting data and testing knowledge.	1.7.0 Has a critical, questioning attitude toward inferences, hypotheses, and theories.
B. Science is a part of our everyday life experiences.	3.5.0 Records observations accurately and organizes data and ideas in ways that improve their usefulness.
1. Science explains many common observable occurrences.	(Skills - II A): The scientific method should be used in writing laboratory reports.
2. Curiosity about common events leads to scientific investigation.	3.3.1 Makes purposeful, objective observations.
3. Observable facts may be distinguished from opinions.	4.1.0 Demonstrates knowledge of the processes of scientific inquiry.
4. Scientific achievements improve our daily lives.	1.8.2 Applies science problem-solving techniques to everyday life situations.
C. Science can be divided into many different fields of study.	
1. Biological (life) science is the study of living things. Some biological sciences are Biology (living things), Zoology (animals), Botany (plants), and Microbiology (small living things).	
2. Physical science is the study of non-living things. Some physical sciences are Chemistry (matter), Physics (energy), Astronomy (the universe), Geology (earth), and Meterology (weather).	

Content	Continuum Skills
D. Science utilizes systems to group together related objects which have certain common properties or functions.	2.2.0 Develops ability to organize data by comparing classifying, relating, and ordering.
1. Classification systems	2.2.1 Perceives similarities and differences in a set of objects; separates a set into groups according to a single characteristic.
2. Biological systems	
3. Ecosystems	
E. Science is an advancing frontier.	
1. Scientific explorations open new areas for investigation.	1.4.3. Seeks to influence the views and behaviors of others with respect to social issues related to science and technology.
2. Future advancements in science and technology are interdependent.	4.3.0 Demonstrates knowledge of relationships between science and society.
II. Who is a scientist? A scientist is any individual who uses scientific procedures to acquire knowledge and understanding.	
A. Attitudes of the scientist include:	1.1.0 Shows curiousity about objects and events.
1. An inquisitive mind.	1.4.0 Takes an active role in solving social problems related to science and technology.
2. Ability to make accurate observations.	1.5.1 Recognizes the alternative factors to be considered when examining possible solutions.
3. The application of critical thinking when investigating relationships and solutions to problems.	1.6.0 Organizes and reports the results of scientific investigations in an honest and objective manner.
4. Careful planning before initiating experiments.	1.7.0 Has a critical, questioning attitude toward inferences, hypotheses, and theories.
5. Accuracy in experimentation.	

Content	Continuum Skills
6. Respect for the judgement of other scientists.	1.8.2 Applies science problem-solving techniques in everyday life situations.
7. The arrival at conclusions based on evidence.	1.10.1 Values the abilities, interests, and preparation required for a science-related career.
8. The organization and reporting of the results in an honest and objective way.	2.4.0 Participate in scientific inquiry at the appropriate level.
B. Scientists are members of society who specialize in the study and application of science.	3.5.0 Records observations accurately and organizes data and ideas in ways that improve their usefulness.
1. Scientists represent men and women of every race and nationality.	4.0.0 Demonstrates knowledge of the processes of inquiry.
2. Ninety percent of all the scientists who ever lived are alive today.	4.8.0 Demonstrates general knowledge of science.
3. Scientists learn by studying the achievements of scientists of the past.	
C. There are many careers in science.	
1. Students interested in pursuing careers in science should plan realistically and conduct research concerning science related opportunities.	

Content	Continuum Skills
III. What tools are utilized by life scientists?	
A. Scientific methods involve use of a series of steps which suggest ways of collecting and testing knowledge.	2.4.0 Participates in scientific inquiry at the appropriate level.
1. Make a clear statement of the problem.	2.4.1 Defines a problem related to an unusual event.
2. Collect information.	2.3.4 Designs experiments to produce specific data to support or refine a hypothesis.
3. Form hypotheses.	2.4.2 Identifies data needed to test a hypothesis; designs an experiment to generate the data; records and organizes data; and evaluates the hypothesis in light of new data.
4. Test the hypotheses.	(Skills - II A): The scientific method should be used in writing laboratory reports.
5. Gather and record data.	
6. Analyze the data.	
7. Accept or reject the hypotheses based on experimentation.	
8. Record and communicate the results.	
B. Scientific notation expresses large and small numbers in a relatively simple manner.	3.8.3 Utilizes exponential notation to express very large and very small numbers.
C. The metric system is used for all scientific measurements and is in common use in most countries of the world.	3.7.0 Uses the metric system effectively.
1. Metric length is based on the meter.	
2. Metric volume is based on the liter.	
3. Metric mass is based on the gram.	
4. The metric system offers several advantages;	

Content	Continuum Skills
a. The metric system is universally understood.	
b. The metric system is based on fractional units of tenths or hundredths, which allows easy conversion of fractions to decimals.	
5. Mathematics and measurement are important tools of the scientist.	
D. The beam balance is used to measure accurately the mass (metric) of an object.	3.7.3 Uses a balance to determine the mass of objects.
E. The graduated cylinder is used to measure accurately the metric volume of a liquid.	(Skills - I C. 2.): Beam balances are very delicate instruments.
F. The microscope is used by scientists for microscopic observations of organisms.	(Skills - I C. 1.): Microscopes are expensive and delicate instruments which should be handled with care.
G. Other laboratory apparatus used by life scientists include:	3.1.0 Assembles and uses laboratory apparatus, tools, and materials in a skillful manner, giving due attention to safety measures.
1. Flasks and beakers	
2. Petri dishes	
3. Dissecting trays, scalpels, and needles	
4. Bunsen burners and alcohol lamps	
5. Ring stands	
6. Litmus paper, filter paper, and lens paper.	
7. Pipettes	

UNIT TWO: WHAT ARE LIVING THINGS? — ONE WEEK

Representative Objectives for This Unit

- Recognize that all living things have the same life processes.
- Appreciate and respect all living organisms, including self and his/her relationship to the environment.
- Understand and describe living organisms that grow and develop in different environment.

Content

I. Living things differ from non-living things.

A. Living things carry on certain life activities, which include: (1) movement, (2) taking in food, (3) waste excretion, (4) respiration, (5) response to stimuli, (6) growth, and (7) reproduction.

B. All living things are made of basic units called cells.

C. All living things come from other living things.

II. Living things are usually classified into three major groups: animals, plants, and protists.

III. Living things depend on each other.

A. Living things use the food sources and territory in ecosystems.

Continuum Skills

1.3.0 Appreciates and respects all living organisms, including self and his/her relationship to the environment.

4.8.2 Recognizes that all living organisms have the same life processes.

4.8.9 Recognizes that a living organism is a product of its heredity and environment.

4.8.1 Recognizes that a cell is the basic unit of structure and function of a living organism.

4.8.4 Understands and describes living organisms that grow and develop in different environments.

Content	Continuum Skills
B. Communities of plants and animals that live together in ecosystems influence each other.	
C. Ecosystems demonstrate the interdependence of plants and animals with each other and with the non-living environment.	(See Sample Lesson: How Living Things Are Different from Non-Living Things.)

UNIT THREE: THE CELL — TWO WEEKS

Representative Objectives for This Unit

- Identify the cell as the unit of structure and function in all living things.
- Compare and contrast animal and plant cells.
- Use appropriate laboratory tools and techniques for observing cells in a safe manner.

Content	Continuum Skills
I. The cell is the basic structure of all living things.	
A. There are two kinds of cells: animal cells and plant cells.	4.8.1 Recognizes that a cell is the basic unit of structure and function of a living organism.
B. Plant and animal cells have some common structures.	
1. The nucleus is the cell's command center.	4.8.2 Recognizes that all living organisms have the same life processes.
2. Cytoplasm surrounds the nucleus and contains structures like ribosomes, mitochondria, and vacuoles, which are important to cell function.	(See Sample Lesson: The Cell.)
3. The cell membrane surrounds the cytoplasm and holds the cell together.	
C. Plant cells have some additional cell structures that animal cells do not have.	
1. Cell walls, made of a woody material called cellulose, surround the cell membranes of plant cells.	

Content	Continuum Skills
2. Chloroplasts, which are located in the cytoplasm, contain chlorophyll, which gives plants their green color and allows them to produce food in the presence of sunlight.	
D. Most cell structures are composed of a living substance called protoplasm.	1.2.0 Recognizes and reports evidence of order and symmetry in the environment.
E. Groups of cells which work together form tissues.	
F. Tissues of various kinds are grouped together to form organs.	
G. Organs which work together are combined into systems.	
II. The nucleus controls the life functions of the cell.	
A. The cell's nucleus contains DNA (deoxyribonucleic acid) molecules.	4.8.10 Recognizes that all forms of life are composed of the same elements in different DNA blueprints.
1. DNA is a code that controls and regulates the cell's activities.	4.8.11 Understands relationships of structure and function of living organisms to their environment.
2. The DNA code activates the production by the ribosomes of proteins, which are necessary for the cell's growth, repair, reproduction, and enzyme manufacture.	
B. The nucleus also controls cell reproduction.	
1. Cells must divide in order to replace dead or injured cells.	

Content	Continuum Skills
2. Mitosis is a process in which body cells divide to form two new and identical cells.	
3. Meiosis is a special kind of cell division to form sex cells.	
III. The cell membrane allows food and oxygen to enter a cell and waste products to leave the cell.	4.8.2 Recognizes that all living organisms have the same life processes.
A. Diffusion is the random movement through the cell membrane of molecules from an area of greater concentration to an area of lesser concentration.	
B. Osmosis is a special kind of diffusion in which water molecules move across the cell membrane.	
IV. The microscope is the most basic tool of the life scientist.	3.1.0 Assembles and uses laboratory apparatus, tools, and materials in a skillful manner, giving due attention to safety measures.
A. No one knows who invented the microscope.	
B. Anton van Leeuwenhoek, a Dutch lensmaker, known as "The Father of Microscopy," first observed microbes through simple microscopes.	1.9.3 Values the scientific contributions of human beings from varying cultural backgrounds.
C. Simple mircoscopes use only one or two convex lenses.	
1. Lenses are curved, transparent materials which bend light rays.	
2. Convex lenses are thicker in the center than at the edges.	

Content	Continuum Skills
3. Convex lenses magnify, invert and reverse images, and converge light rays to a point.	
D. Compound microscopes use a system of convex lenses.	(Skills I C.): Microscopes are expensive and delicate instruments which should be handled with care.
1. Robert Hooke is credited with inventing the compound microscope, through which he observed cells.	
2. Compound microscopes have such basic parts as objective lenses, a body tube, adjustment knobs, a mirror, a stage, and a diaphragm.	
3. Students should be familiar with parts of the microscope and the uses of these parts before actually using the microscope.	3.1.1 Manipulates simple materials, apparatus, and equipment in a safe manner.
4. Students should be properly trained in the use and the care of compound microscopes.	
E. Electron microscopes are powerful instruments which use beams of electrons instead of light to form images of small objects.	

UNIT FOUR: CLASSIFICATION OF LIVING THINGS

ONE WEEK

Representative Objectives for This Unit

- Describe systems of classification used to sort groups of objects.
- Demonstrate the use of a classification system based on observable characteristics.
- List the seven steps in the modern binomial system of taxonomy.

Content

I. Taxonomy is the science of classification.

II. Taxonomists classify living things into groups according to their structures.

A. Living things are usually classified into three major groups:

1. The Animal Kingdom
2. The Plant Kingdom
3. The Protist Kingdom

B. Some classification systems recognize as many as five kingdoms.

C. There is also some disagreement as to which organisms should be classified as protists.

Continuum Skills

1.2.0 Recognizes and reports evidence of order and symmetry in the environment.

4.2.11 Describes systems of classification used to sort a group of miscellaneous objects.

4.2.12 Recognizes that classifications systems are developed by humans for the use of humans and are one way of helping them to understand the basic organization and pattern of nature.

(See Sample Lesson: Classification of Various Objects.)

Content	Continuum Skills
III. The classification system concerns the division of larger groups into smaller and smaller groups.	
A. Kingdoms are divided into phyla.	
B. Phyla are divided into classes.	
C. Classes are divided into orders.	
D. Orders are divided into families.	
E. Families are divided into genera.	
IV. Carolus Linnaeus (1707-1778), a Swedish scientist, developed the binomial nomenclature system for classifying living things.	1.0.3 Values the scientific contributions of human beings from varying cultural backgrounds.

UNIT FIVE: PROTISTS

ONE WEEK

Representative Objectives for This Unit

- Describe the characteristics of Kingdom Protista.
- Recognize that all living organisms have the same life processes.
- List the harmful and beneficial effects of protists.
- Compare and contrast viruses, bacteria, and protozoans.

Content

I. Protists are the simplest living things.

- A. Protists exhibit both animal and plant characteristics.
- B. Protists include viruses, bacteria, and protoza.
- C. Some classification systems include algae, fungi, molds, and slime molds as protists.

II. Scientists disagree as to whether viruses are actually living things.

- A. Viruses do not grow or move like living things, and they have no cell parts.
- B. Viruses seem to be a link between the living and non-living worlds.
- C. Viruses are both harmful and beneficial to humans.

Continuum Skills

2.3.2 Gathers own data to form own point of view, satisfying any former contradictions.

2.3.3 Recognizes contradictions and unusual events.

3.4.2 Gathers information from science textbooks, reference materials, science films, and television.

4.8.2 Recognizes that all living organisms have the same life processes.

4.8.1 Recognizes that a cell is the basic unit of structure and function of a living organism.

4.8.4 Understands and describes living organisms that grow and develop in different environments.

Content

1. Harmful viruses cause the common cold, mumps, chicken pox, measles, influenza, and polio.

2. Beneficial viruses help control the harmful insect population and help scientists learn how DNA works.

III. Bacteria are one-celled living things.

A. Bacteria are classified by their shapes.

1. A bacillus is a rod-shaped bacterium.

2. A coccus is a round bacterium.

3. Spirilla are spiral-shaped bacteria.

B. Some bacteria are harmful to living things and others are beneficial

1. Harmful bacteria cause strep throat, tuberculosis, tetanus, pneumonia, food poisoning, and spoilage.

2. Beneficial bacteria break down dead matter and even protect humans against other bacteria which cause diseases.

3. Other beneficial bacteria are used to make cheeses, yogurt, and detergents.

IV. Protozoa include one-celled, animal-like protists.

A. Protozoa are classified by the ways in which they move:

1. Ciliates, such as paramecia, vorticella, stentors, move by tiny, hair-like structures called cilia.

Continuum Skills

(Skills - I B. 7.): Petri dishes containing bacteria or molds should be taped securely and disposed of properly.

4.8.11 Understands relationships of structure and function of living organisms to their environment.

(See Sample Lesson: Protists.)

2. Sarcodinians, such as the amoeba, form pseudopods ("false feet") for movement.

3. Flagellates, such as euglena and volvox, possess whip-like flagella to propel themselves.

4. Sporozoans cannot move about to get food.

B. Most protozoa reproduce asexually by splitting in half, but some reproduce sexually and others produce spores.

C. Some protozoans cause diseases, such as amoebic dysentery and malaria.

UNIT SIX: PLANTS

THREE WEEKS

Representative Objectives for This Unit

- List the characteristics of plants.
- Compare and contrast algae, fungi, nonvascular, and vascular plants.
- Recognize that the sun is the source of energy for green plants.
- Discuss the importance of the seed and flower.

Content

I. The simplest plants lack leaves, roots, and stems.

A. Algae are simple aquatic plants which contain chlorophyll, the green substance which enables plants to manufacture food in the presence of sunlight.

1. Algae are grouped according to their color and structure.
2. Algae supply more oxygen to the air than all land plants combined.
3. Algae are the main source of energy for aquatic animals.
4. Algae are used in making food (ice cream, yogurt, bread, soup) and many industrial products.
5. Algae may become a very important human food source in the future.

Continuum Skills

3.4.2 Gathers information from science textbooks, reference materials, science films, and television.

4.8.5 Recognizes that the sun is the source of energy for green plants and is basic to the growth and maintenance of living organisms.

4.2.11 Describes systems of classification used to sort a group of miscellaneous objects.

4.2.12 Recognizes that classification systems are developed by humans for the use of humans and are one way of helping to understand the basic organization and pattern of nature.

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Content	Continuum Skills
6. Spirogyra, diatoms, and seaweed are some examples of algae.	
B. Fungi are simple plants which do not contain chlorophyll.	(See Sample Lesson: Algae and Fungi.)
1. Fungi cannot make their own food.	4.8.7 Recognizes that living organisms utilize matter and return it to the environment.
2. Fungi get their energy from other living things or things that once lived.	
3. Many fungi are parasitic.	
4. Yeasts are one-celled fungi, which are needed to make bread and alcohol.	
5. Molds are fungi which are both harmful and beneficial to humans.	
a. Harmful molds cause diseases in plants and animals, spoil food, and cause bread mold, ringworm, and athletes' foot.	4.3.1 Gives examples of ways in which the use of scientific knowledge has affected society.
	(Skills - I. B. 5.): Animal or plant specimen bottles should never be opened.
b. Beneficial molds are used to make cheeses and medicines (penicillin, tetramycin, and vibromycin).	
6. Mushrooms may be edible or poisonous to humans. No wild mushroom should ever be eaten unless collected by an expert.	
II. Complex plants live on land and are classified as either nonvascular or vascular.	4.2.11 Describes systems of classification used to sort a group of miscellaneous objects.

Content	Continuum Skills
A. Nonvascular plants do not have tubes for carrying food, water, and minerals.	4.8.4 Understands and describes living organisms that grow and develop in different environments.
1. Nonvascular plants do not have "true" roots, stems, or leaves.	
2. Mosses and liverworts are examples of nonvascular plants.	
3. Mosses and liverworts are food for some animals; this type of plant holds the soil in place, preventing erosion; and one kind of moss forms peat which is a source of fuel.	
4. Mosses and liverworts reproduce in a two-stage process, which alternates asexual and sexual stages.	
B. Vascular plants have tubes for carrying food, water, and minerals.	(Skills - I. B 4.): Holiday, weekend, or vacation care of plants and animals should be planned in advance.
1. Vascular plants have true roots, stems, and leaves.	
2. Ferns and seed plants are examples of vascular plants.	
3. Over millions of years, the remains of ferns were subject to a chemical process which changed them into coal. Today coal is burned to produce energy.	4.2.8 Recognizes the uses of fuels.
4. Like mosses and liverworts, ferns reproduce in a two-stage process, which alternates asexual and sexual stages.	

Content

Continuum Skills

5. Ferns produce spores for reproduction.

6. Seed plants reproduce by means of seeds.

III. The most common land plants are seed plants.

A. Gymnosperms are seed plants which produce seeds that have no outer covering.

1. Gymnosperms include pines, spruces, and hemlocks.

2. Gymnosperms produce cones with naked seeds.

3. Gymnosperms usually have needle-like leaves.

4. Gymnosperm trees provide lumber, fuel, varnish, and turpentine.

B. Angiosperms are seed plants which produce seeds within a protective covering.

1. Angiosperms produce flowers and fruits (to protect the seeds).

(See Sample Lesson: Flower Dissection.)

2. Angiosperms belong to the most successful group of plants on earth.

3. Angiosperms include maples, oaks, elms, fruit trees, vegetables, bushes, vines.

4. Some angiosperms must be planted each year (annuals); others are biennials (grow for two seasons) or perennials (grow year after year).

5. Angiosperms provide fruit, lumber, grains, syrup, and paper and give off oxygen.

C. Angiosperms are either Monocot or Dicot.

1. Monocots are angiosperms with only one seed leaf (cotyledon).

a. Monocots have leaves with parallel veins.

b. Monocots have flowers with 3, 6, or 9 petals.

c. Monocots have narrow leaves.

d. Corn, grasses, and bamboo are monocot plants.

2. Dicots are angiosperms with two seed leaves.

a. Dicots have broad leaves with branching veins.

b. Dicots have flowers with 4 or 5 petals.

c. Maples, oaks, fruit trees, and vegetables are dicots.

IV. Seed plants have special structures.

A. Food for the plant is produced in the leaves.

1. Photosynthesis is the process in which chlorophyll, sunlight, carbon dioxide, and water are used to make food for the plant.

2. During this process, leaves give off oxygen to the air.

B. Stems support the leaves and transport water, food, and minerals.

1. Xylem are tubelike structures which conduct water from the roots to the leaves of plants.

2. Phloem are tubelike structures that move food from the leaves to the roots.

3. Herbaceous stems are soft, green, and flexible. Plants with herbaceous stems usually live only one or two growing seasons.

4. Woody stems are thick, hard, and rigid. Plants with woody stems, like trees and shrubs, grow year after year.

C. Roots absorb water and minerals from the soil and anchor the plant.

V. Seed plants have special structures for reproduction.

A. Flowers are the reproductive structures of seed plants.

1. Stamens are the male parts of the flower.

2. Pistils are the female parts of the flower.

UNIT SEVEN: ANIMALS — FOUR WEEKS

Representative Objectives for This Unit

- Describe the characteristics of animals.
- Maintain animals for safe laboratory use.
- Demonstrate the use of a classification system based on observable characteristics.
- Describe the major organ systems in animals.

Content	Continuum Skills
I. Invertebrate animals have no backbones.	
A. Pore-bearing animals (Phylum Porifera) have bodies covered with tiny openings or pores.	1.3.0 Appreciates and respects all living organisms, including self and his/her relationship to the environment.
1. The many varieties of fresh and salt water sponges are classified in this group.	1.3.1 Accepts responsibility for the care of living organisms in natural and artificial environments.
2. Sponges are the simplest of all the many-celled invertebrate animals and have two layers of cells.	2.2.1 Perceives similarities and differences in a set of objects; separates a set into groups according to a single characteristic.
3. Adult sponges do not move from one place to another like most animals.	2.2.2 Develops arbitrary classification systems wherein objects can be put into mutually exclusive categories; uses quantitative measurements as criteria for grouping.
4. Sponges reproduce both sexually and asexually.	2.4.0 Participates in scientific inquiry at the appropriate level.
5. Sponges can regenerate new parts.	

Content

B. Animals found in Phylum Coelenterata have hollow bodies like empty sacs.

1. Jellyfish, hydras, coral polyps, Portuguese men-of-war, and anemones are classified in this animal group.

2. Like sponges, the coelenterates have two cell layers.

3. Most coelenterates have arm-like tentacles with stinging cells for catching prey.

4. Hollow-bodied animals reproduce both sexually and asexually.

C. Worms are classified into three phyla, according to their shapes and structures.

1. Phylum Platyhelminthes include the flat worms.

a. Flatworms are the simplest of all the worms.

b. Flatworms and all other higher animal groups have three cell layers.

c. Most flatworms are parasites, and many cause diseases.

d. Planaria, tapeworms, and flukes are examples of flatworms.

2. Worms with round bodies are classified in Phylum Nematoda.

Continuum Skills

3.1.0 Assembles and uses laboratory apparatus, tools, and materials in a skillful manner, giving due attention to safety measures.

3.2.1 Handles plants and animals carefully, following suggested procedures.

3.4.2 Gathers information from science textbooks, reference materials, science films, and television.

3.6.0 Communicates with others in a manner that is consistent with the student's knowledge.

Content

a. Roundworms are among the most numerous and most widespread of all the many-celled animals.

b. Nematodes, vinegar eels, hookworms, and trichina worms are roundworms.

c. Many roundworms are parasites.

d. Many roundworms are harmful to other living things.

3. Worms with segmented bodies are classified in Phylum Annelida.

a. Segmented worms are the most complex of the worm groups.

b. Segmented worms have well developed organs and body systems.

c. Earthworms, bristle worms, and leeches are some examples of segmented worms.

d. Earthworms are important enrichers of soil.

D. Animals in Phylum Mollusca have soft bodies and are usually covered by a shell.

1. Mollusks have a head and a muscular foot for movement.

2. Mollusks are classified into groups according to type of foot, the type of shell, and whether or not a shell is present.

Continuum Skills

4.8.2 Recognizes that all living organisms have the same life processes.

4.8.4 Understands and describes living organisms that grow and develop in different environments.

4.8.9 Recognizes that a living organism is a product of its heredity and environment.

4.8.11 Understands relationships of structure and function of living organisms to their environment.

4.8.12 Recognizes that living organisms have changed over the ages and that some species are now extinct.

(Skills - I. B. 1.): Laboratory animals should be cared for properly.

(Skills - I. B. 2.): Aquaria and animal cages should be cleaned regularly.

(Skills - I. B. 3.): Animals should be fed and watered following a definite schedule.

(Skills - I. B. 4.): Holiday, weekend, or vacation care of plants and animals should be planned in advance.

(Skills - I. B. 5.): Animal or plant specimen bottles should never be opened.

(Skills - I. B. 6.): Animal specimens preserved in formaldehyde or formalin should be washed thoroughly before being handled.

(See Sample Lesson: Animal Kingdom Classification.)

3. Univalves are one-shelled mollusks and include snails.

4. Bivalves are two-shelled mollusks, which include clams, mussels, oysters, and scallops.

5. The octopus and squid are mollusks that do not possess a shell to protect their soft bodies.

6. Soft-bodied animals are an important food source. Some are garden pests, and others are prized for their pearls.

E. Spiny-skinned animals (Phylum Echinodermata) have bodies covered with spines.

1. Some spiny skinned animals have round bodies covered with spines, while others have star shaped bodies.

2. Starfish, sand dollars, sea urchins, and sea cucumbers are examples of spiny-skinned animals.

3. Echinoderms are important in scientific research, such as in the study of embryo development and tissue replacement.

F. Animals in Phylum Arthropoda are invertebrate animals with jointed legs and jointed bodies.

1. There are more jointed-legged animals than there are animals in all the other animal phyla combined.

2. All jointed-legged animals have an outside shell, called an exoskeleton.

3. Arthropods have bodies usually divided into sections called the head, the thorax, and the abdomen.

4. Appendages (arms, legs, wings, feelers, mouth parts) are attached to the arthropod's body.

5. Arthropods are classified into groups according to the number of pairs of legs they have.

   a. Crustaceans, such as crayfish and crabs, are arthropods which usually have five pairs of legs.

   b. Insects are arthropods with three pairs of legs, such as bees, ants, grasshoppers, beetles, and butterflies.

   c. Arachnids are arthropods with four pairs of legs, such as spiders and ticks.

   d. Centipedes and millipedes are many-legged arthropods.

6. Some arthropods are important food sources (shrimps, lobsters). Many insects are garden pests, but others are important in flower pollination.

Content

II. Vertebrate animals have backbones.

A. Fish are aquatic and marine vertebrates.

1. Sharks, skates, and rays are cartilaginous fish.

a. They have skeletons made of cartilage, not bone.

b. All the largest living fishes are sharks.

2. True fish have bony skeletons.

a. Fish use gills for respiration.

b. Limbs take the form of fins.

c. They have an outer covering of scales.

3. Fish live in every water environment.

4. Reproduction may occur either externally or internally.

B. Amphibians are cold-blooded vertebrates that have a two-stage life.

1. During one stage of their lives, amphibians live in the water and breathe with gills; during the second stage, they live on land and breathe with lungs.

2. Frogs, toads, salamanders, and newts are examples of amphibians.

Continuum Skills

4.8.0 Demonstrates general knowledge of science.

4.8.11 Understands relationships of structure and function of living organisms to their environment.

3.2.0 Demonstrates proper techniques for handling and caring for living organisms.

3. Amphibians have a smooth, moist skin.

4. Amphibians reproduce by laying eggs in water; their eggs are fertilized externally.

5. Amphibians are classified according to their structure: those without tails (such as frogs and toads) and those with tails (such as salamanders and newts).

6. Amphibians hibernate during cold periods.

7. Amphibians metamorphose from a larval to an adult stage.

C. Reptiles are cold-blooded vertebrates that live mostly on land.

1. Reptiles have well-developed lungs for breathing on land.

2. Reptiles have dry, scaly skin or hard plates that cover their bodies and prevent water loss.

3. Snakes, lizards, turtles, alligators, and crocodiles are reptiles.

4. Reptiles reproduce by internal fertilization, and produce eggs with leathery shells.

5. Reptiles are classified into three groups according to body structure:

a. Snakes and lizards have hard, dry scales.

b. Turtles have two bony shells.

c. Alligators and crocodiles have long, scaly bodies with large heads.

6. There are only four kinds of poisonous snakes in the United States: coral snakes, rattlesnakes, water moccasins, and copperheads.

7. Reptiles help keep a balance in nature by eating insects, rodents, and small animals.

8. Reptiles and their eggs are food sources in some parts of the world; alligator and snake skins are used for making shoes and belts; snake venom is used for making pain-killing drugs.

D. Birds are warm-blooded vertebrates.

1. Warm-blooded vertebrates, like birds and mammals, keep a high and fairly even body temperature.

2. Feathers are the body cover of birds.

3. Birds have a four-chambered heart and breathe with lungs.

4. With two wings and light weight bones, birds are well adapted for flight.

5. The shape and size of a bird's beak give an indication of the different kinds of foods that birds eat.

6. The structure of a bird's feet is adapted to how it moves about, where it lives, and how it gets food.

7. Birds reproduce by internal fertilization and lay eggs with brittle shells.

8. Birds are important to humans in many ways, such as by serving as food sources and checking insect population. Birds are also popular pets.

E. Mammals are the most advanced vertebrate form.

1. Like birds, mammals are warm-blooded, breathe with lungs, and have a four-chambered heart.

2. Mammals have highly developed body systems.

3. Mammals have a body covering of hair.

4. Female mammals feed their young with milk produced in special organs called mammary glands.

5. Mammals are the most intelligent vertebrates.

6. Mammals are grouped according to three main ways in which they differ:

   a. How their young are born and how they develop (egg-laying mammals, pouched mammals, placental mammals).

   b. Foot structure, which determines how the mammal moves.

c. The kinds of teeth mammals have for cutting, tearing, or grinding food.

7. Mammals reproduce by internal fertilization; and, in most animal orders, the developing young are carried in the mother's body.

8. Of all the mammal orders, the primates are the most highly developed.

9. Humans are primates and have the most highly developed brains.

UNIT EIGHT: HEREDITY

ONE WEEK

Representative Objectives for This Unit

- Identify dominant and recessive traits.
- Recognize the gene as the unit of inheritance.
- Recognize that all living organisms have the same life processes.
- Identify genetic engineering as a growing research endeavor.

Content	Continuum Skills
I. Genetics is the science of heredity.	
A. Heredity is the passing of traits from one generation to the next.	1.4.2 Develops and expresses an opinion on a social issue.
B. Gregor Mendel, an Austrian monk, is the "Father of Genetics."	1.5.2 Examines a variety of alternative viewpoints on scientific issues to form opinions about them.
1. Mendel discovered the principles of genetics.	1.9.3 Values the scientific contributions of human beings from varying cultural backgrounds.
2. Mendel found mathematical patterns in his genetic tests with pea plants.	4.8.10 Recognizes that all forms of life are composed of the same elements in different DNA blueprints.
II. Traits are characteristics (such as eye color, skin color, leaf shape) that are passed from parent to offspring.	
A. Some traits are dominant, others recessive.	4.8.2 Recognizes that all living organisms have the same life processes.
1. A dominant trait masks the appearance of another trait.	
2. A recessive trait is hidden by a dominant trait.	(See Sample Lesson: Heredity in the Classroom.)

3. Hybrids are organisms that contain a dominant unit and a recessive unit for a particular trait.

4. A phenotype is the physical appearance of inherited traits.

5. A genotype is the gene makeup of an organism.

6. Incomplete dominance is the blending of two different traits, neither gene being dominant.

B. Punnett Squares can be used to diagram possible combinations of hereditary characteristics and to predict the ratio of those characteristics in the offspring.

III. Heredity is determined in the cells.

A. Genes are units found on the chromosomes in the nuclei of cells.

1. Genes contain the information about traits that an organism inherits from its parents.

2. Genes are arranged on the chromosomes in a definite pattern.

3. Genes are made of DNA (deoxyribonucleic acid), a very large molecule made up of nitrogen bases, sugar and phosphate units.

B. Chromosomes are structures found in the nuclei of cells.

1. All humans have 23 pairs of chromosomes.

2. The 23rd pair of chromosomes are called the "sex chromosomes."

3. Males have one large X chromosome and one small Y chromosome (XY).

4. Females have two X chromosomes (XX).

5. The X or Y chromosome is inherited from the father and determines, at fertilization, the sex of the organism.

6. Genes carred on the X chromosome, but not on the Y, are called sex-linked genes and cause such traits as color blindness, baldness, and hemophilia.

IV. Genetic engineering is a new and growing field of research.

A. One type of genetic engineering introduces new genes into bacteria to produce substances for medical use.

B. Genetic engineering is also being used in the preparation of life-saving proteins, such as bacterial insulin.

UNIT NINE: ECOLOGY AND CONSERVATION

TWO WEEKS

Representative Objectives for This Unit

- Appreciate the interdependence of living organisms in the natural environment and the implication for continued survival.
- Describe major biomes.
- Recognize the importance of energy levels as related to ecosystems.
- Recognize the value of using renewable energy sources instead of nonrenewable sources.
- Explain the effects of pollution on the environment.

Content

I. Ecology is the study of how living things interact with each other and with the non-living factors in their environments.

   A. An ecosystem is a community of living things and its interaction with the physical environment.

      1. Ecosystems may be as small as aquariums or terrariums or as large as forests, ponds, lakes, or oceans.

Continuum Skills

1.2.0 Recognizes and reports evidence of order and symmetry in the environment.

1.3.0 Appreciates and respects all living organisms, including self and his/her relationship to the environment.

1.3.2 Appreciates the interdependence of living organisms in the natural environment and the implications for continued survival.

1.4.0 Takes an active role in solving social problems related to science and technology.

1.10.1 Values the ability, interests, and preparations required for a science-related career.

2.3.1 Examines environmental issues, pointing out contradictions and discrepancies in the positions of various groups.

Content	Continuum Skills
	3.4.2 Gathers information from science textbooks, reference materials, science films, and television.
2. Only certain kinds of animals and plants can live in a particular ecosystem.	4.8.4 Understands and describes living organisms that grow and develop in different environments.
3. The non-living factors in an ecosystem have an important role in determining which kinds of plants and animals can survive in a particular ecosystem.	
a. Light, air, soil type, and temperature are examples of non-living factors in an ecosystem.	
b. Energy from the sun, in the form of light, is needed to run every ecosystem.	4.8.5 Recognizes that the sun is the source of energy for green plants and is basic to the growth and maintenance of living organisms.
c. Non-living materials, such as oxygen, carbon dioxide, nitrogen, and water, move through the environment in a series of steps called a cycle.	(See Sample Lesson: Ecological Biomes.)
B. Biomes are groups of ecosystems with similar plant and animal communities and climate.	
1. The major biomes are the tundra, the coniferous forest, the deciduous forest, the grassland, the desert, and the rain forest.	

Content

2. In each biome, only certain kinds of animals and plants can survive.

II. Conservation is the wise use of the earth's resources. Preservation is the saving of resources by withdrawing them from use.

A. Natural resources are living things and materials in the environment that are needed to support life.

1. Some resources are renewable and can be replaced in a reasonably short period of time.

2. Other resources, such as fossil fuels (coal, oil, natural gas), are nonrenewable resources which cannot be replaced.

3. Natural resources can be managed through conservation.

B. Endangered species of certain animals and plants result from destruction of habitats and poisonous chemicals. Illegal hunting of animals may also cause some species to become endangered.

C. Pollution results from the adding of harmful amounts of a substance to the environment.

1. Air is polluted by the burning of fuels. Air pollution can react with other substances in the atmosphere. This may cause smog or acid rain.

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Continuum Skills

4.8.6 Recognizes the importance of energy levels as related to ecosystems.

4.8.7 Recognizes that living organisms utilize matter and return it to the environment.

4.8.11 Understands relationships of structure and function of living organisms to their environment.

4.8.25 Recognizes the value of using renewable energy sources instead of nonrenewable sources.

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2. Water pollution results from the dumping of wastes, chemicals, and sewage.

3. Land is polluted by the dumping of garbage and hazardous wastes.

D. New laws and solutions to pollution, fishing, and hunting problems as well as limiting use of pesticides may be needed to conserve resources. Improved enforcement of existing laws would also assist in conserving resources.

LESSON PLANNING

Successful teaching begins with careful planning. Nine sample lessons are presented on pages 48 to 85.

The lesson plans follow the format of the seven-point, teacher-directed instructional sequence. The questions below need to be considered when an instructor is designing a teacher-directed instructional sequence:

- What is the specific objective and how will it be presented to the students?
- What is the value in achieving the objective?
- What learning activities must be modeled, explained, or illustrated for students?
- What guided group practice will be provided for the students?
- What independent practice or activity will be provided for the students?
- What provisions will be made for individual differences in learning styles?
- How will the lesson be evaluated?

SAMPLE LESSON I: HOW LIVING THINGS ARE DIFFERENT FROM NON-LIVING THINGS

Course: Biological Science 7

Representative Objectives: Classify living things on the basis of observable characteristics.

Skills Emphasized: Speaking, writing, reading, listening.

Thinking/Cognitive Skills: Analysis

1. Specific Objective

   Students will be able to recognize the differences between living and non-living things.

2. Value to Students

   Students develop observational skills in comparing living organisms to non-living things.

3. Initial Instruction/Teacher Presentation

   Teacher introduces the concept of living versus non-living by lecture.

   Teacher sets up a collection of living things and non-living things.

   Teacher prepares a worksheet for students to enter their observations and conclusions about the displayed subject being living or non-living.

   If available, a microprojector can be used to show crystallization on a small piece of copper wire, using silver nitrate solution. It "grows" like a tree. Teacher can question students about its being living or non-living.

4. Guided Group Practice

   Teacher demonstrates various identified subjects for students to determine whether they are living or non-living. Students record their determinations on the worksheet.

5. Independent Practice

   Students are given an assignment to make a list of as many living and non-living things as they can find in their home.

6. Individual Differences and Learning Modalities

Remediation/alternative activities: Students who understand the differences between living and non-living things can help those students who do not.

Enriched/supplemental activities: Students make a collection of pictures of living things and non-living things.

7. Evaluation

Students will be able to recognize differences between living and non-living things in an identification quiz.

SAMPLE LESSON II: THE CELL

Course: Biological Science 7

Representative Objective: The student will be able to classify living things on the basis of observable characteristics.

Skills Emphasized: Reading, writing, listening, speaking.

Thinking/Cognitive Skills: Knowledge

1. Specific Objective

   Students will be able to identify cell structures and to recognize the differences between animal and plant cells.

2. Value to Students

   Students are able to identify various cell structures and to recognize that plant cells and animal cells differ in some structures.

3. Initial Instruction/Teacher Presentation

   Teacher reviews procedures for use and care of the microscope and identifies its parts.

   Teacher introduces students to cells through use of reading assignments, lectures, overhead transparency projections, or microprojector viewings of typical cells.

   Teacher sets up microscopes for cell observations.

   Materials Needed

Microscopes	Prepared blood slides
Slides	Elodea leaves
Lens paper	Thin cork slices or prepared cork cell slides
Flat toothpicks	Diluted iodine solution

4. Guided Group Practice

   Students are assigned to groups at various microscope locations. Teacher instructs students how to

prepare cheek cell (epithelial) slides and elodea slides. Students observe and draw pictures of epithelial cells, elodea cells, cork cells, and blood cells.

5. Independent Practice

Students are given a worksheet to help them to identify cell structures and to list the differences between animal and plant cells.

6. Individual Differences

Remedial: Review cell structures with overhead projection or flash cards, cell filmstrips, student posters.

Enrichment: Instruct students to make reports on additional cell structures, cell filmstrips, posters of cells and their structures, 3-D models of plant and animal cells, and DNA models.

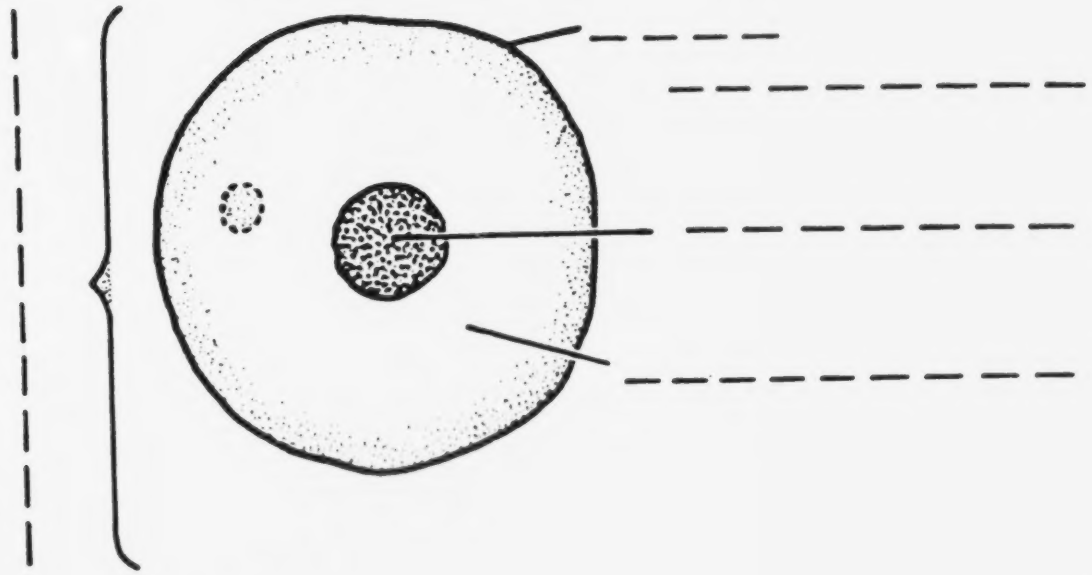
7. Evaluation

Teacher prepares tests on cell structure and on the differences between plant and animal cells.

Cytologist _____

Per. _____ Table _____

A TYPICAL CELL AND ITS STRUCTURES (CHART)



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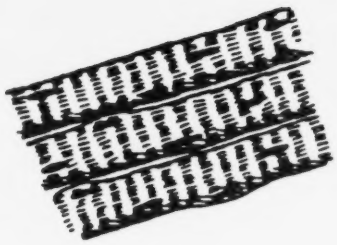
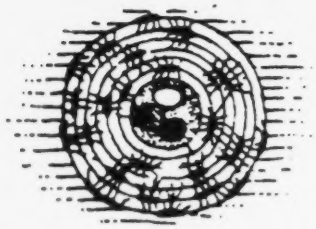
CELL STRUCTURE	FUNCTION
Cell membrane	
Cytoplasm	
Nucleus	

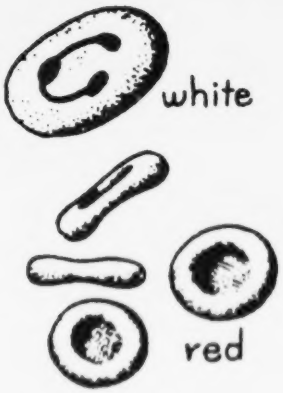
UNSCRAMBLE THESE WORDS (See above.)

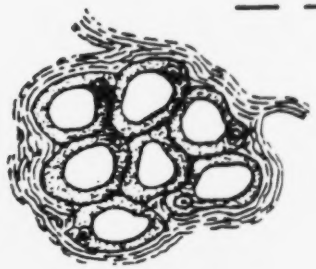
1. SUCULEN _ _ _ _ _ _ _
2. SYTOCLAPM _ _ _ _ _ _ _ _ _
3. EMLLECEMARBN _ _ _ _ _ _ _ _ _ _ _ _ _

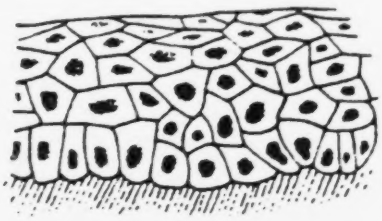
KINDS OF BODY CELLS











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Which kind of cells would be used in the following?

1. Nose bleed _____
2. Broken arm _____
3. Lifting weights _____
4. Seeing _____
5. Cut finger _____
6. Eating a hamburger _____
7. Dandruff problem _____
8. Hearing _____
9. Handwriting _____
10. Throwing a football _____
11. Face scratch _____

Cytologist: _____

Per. _____ Table _____

CELL STRUCTURE CHART

	Blood	Cork	Onion	Elodea	Cheek
Plant cell					
Animal cell					
Has a nucleus					
Has cytoplasm					
Has cell membrane					
Has cell wall					
Chloroplasts					

Questions:

1. Which of the cells observed were animal cells?
2. Which of the cells observed were plant cells?
3. Which cells have a nucleus?
4. Which cells have cytoplasm?
5. Which cells have cell membranes?
6. Which cells have cell walls?
7. Which cells have chloroplasts?
8. What substance makes the chloroplasts green?

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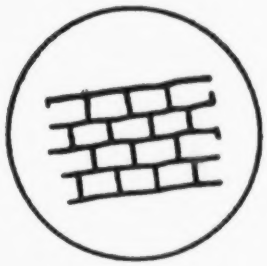
9. List THREE differences between plant and animal cells.

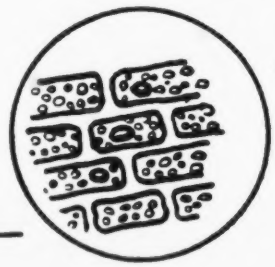
Plant cells have _____

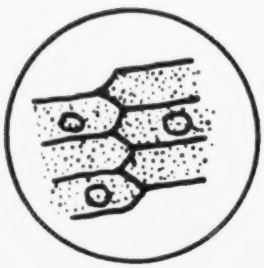
Plant cells have _____

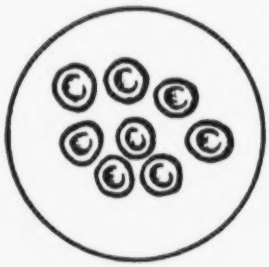
Animal cells are _____ (shape)

Identify the following cells:









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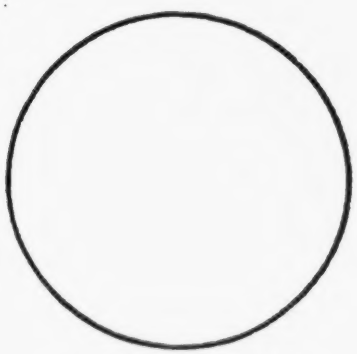
Cytologist:_____

Per._____ Table _____

CELL ACTIVITIES

Onion skin cells

Observe the onion skin cells under the high-power objective lens. The cells will be magnified 430 times. On this and a separate sheet of paper record your responses.



Onion Skin Cells
(430 x)

1. Make a sketch of a few onion skin cells in the circle at the left.
2. What is the general shape of the cells?
3. Do the cells have a cell wall?
4. Iodine was dropped on the onion skin. Why?
5. Can you see a dark, round structure inside the cell? What is this structure called?
6. Label all cell structures that you can see in your drawing.
7. Is the onion skin cell plant or animal? Explain your answer.

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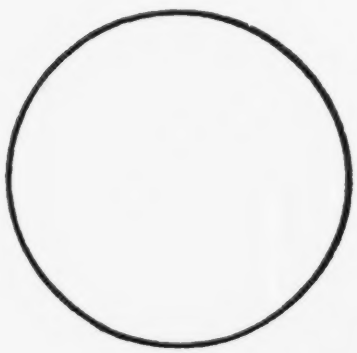
Elodea cells

Observe the elodea cells under the high-power objective lens (430x).

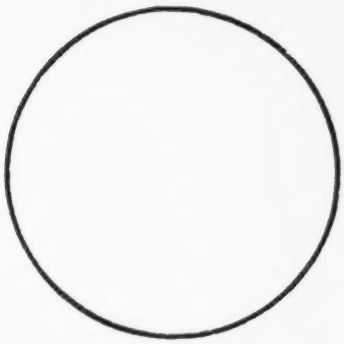


Elodea Cells
(430 x)

1. Make a sketch of a few elodea cells in the circle at the left.
2. What color is the inside of the cell?
3. Is the color located in certain bodies or spread throughout the cell?
4. How many of these bodies (chloroplasts) can you count in one cell?
5. What substance gives the chloroplasts their color?
6. Did you observe cell walls in the elodea cells?
7. Did you observe a nucleus in the elodea cells?
8. Did you observe a cell membrane in the elodea cells?
9. Is the elodea cell plant or animal? Explain your answer.

Human Cheek Cells

Observe the cheek cells under high power magnification.

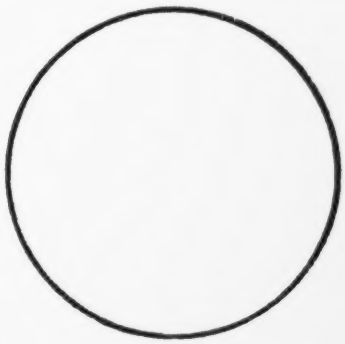


Cheek Cells
(430 x)

1. With a toothpick (flat end), scrape cells from your inner cheek and place material on a slide. Add a drop of Iodine.
2. Make a sketch of cheek cells in the circle on the left.
3. What cell parts did you observe in both the onion and elodea cells and in the cheek cell?
4. Are cheek cells plant or animal? Explain your answer.

Prepared Blood Slides

Observe the prepared blood slides under high power magnification.



Blood Cells
(430 x)

1. What is the general shape of the blood cells?
2. Make a sketch of some blood cells in the circle at the left.
3. What cell structures can you observe?

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SAMPLE LESSON III: CLASSIFICATION OF VARIOUS OBJECTS

Course: Biological Science 7

Representative Objective: Demonstrates understanding of basic generalizations, relationships, and principles.

Skills Emphasized: Speaking, reading, listening, writing.

Thinking/Cognitive Skills: Analysis

1. Specific Objective

   Students will recognize the similarities and differences between various objects and classify them in groups.

2. Value to Students

   Students will be able to classify various objects into groups and to apply later these observational skills to classifying animals, plants, and protists.

3. Initial Instruction/Teacher Presentation

   Teacher introduces taxonomy with lecture on Carolus Linnaeus and the steps of classification (kingdom, phylum, class, order, family, genus, species).

   Teacher prepares boxes of objects of various shapes and colors or prepares worksheet of pictures of different living and non-living things.

4. Guided Group Practice

   Students work in groups and decide which objects or pictures have similarities which can be used in placing them into identifiable groups.

5. Independent Practice

   Students are given additional worksheets containing drawings of various objects or pictures to be used in classifying them into groups.

6. Individual Differences and Learning Modalities

   Remediation/alternative activities: Students who do not understand the concept of classification are assigned to work with students who do. Overhead projections or flashcards can be used to review different objects for classification.

Enriched/supplemental activities: Instruct students to prepare a written or oral report on the work of Carolus Linnaeus.

7. Evaluation

Students discuss why they classified similar objects into various groups. Class members take a teacher-designed test on the subject.

SAMPLE LESSON IV: PROTISTS

Course: Biological Science 7

Representative Objective: Classify living things on the basis of observable characteristics.

Skills Emphasized: Speaking, writing, reading, listening.

Thinking/Cognitive Skills: Knowledge

1. Specific Objective

   Students will observe and recognize some members of the Protist Kingdom.

2. Value to Students

   Students are able to recognize other living organisms which are not classified as plants or animals.

3. Initial Instruction/Teacher Presentation

   Teacher introduces students to the Protist Kingdom by lecture or use of overhead projections.

   Teacher prepares petri dishes with sterilized agar for students to make bacterial cultures which are to be observed later in the laboratory exercise. (This should be done a week before the actual protist laboratory session.)

   Teacher prepares a laboratory sheet on which students are to record their observations.

   If available, a microprojector can be used to project prepared slides of protists.

   Teacher sets up laboratory for protist observations.

   Materials Needed

Microscopes	Living protozoa specimens
Prepared protist slides	Petri dishes
	Agar for growing bacteria

4. Guided Group Practice

   Teacher reviews use and care of microscope. Students observe prepared protist slides and slides of living protozoa specimens (paramecium, euglena, amoeba, etc.). Students observe bacterial colonies in petri dishes. Students record their observations on teacher-designed laboratory worksheet.

5. Independent Practice

Students complete laboratory reports.

6. Individual Differences and Learning Modalities

Remediation/alternative activities: Overhead projections or flashcards can be used to review different bacterial shapes and protozoa. Show film loops or filmstrips about protists.

Enriched/supplemental activities: Instruct students to make oral or written reports on various members of the Protist Kingdom. Request that students make poster-sized drawings of protists.

7. Evaluation

Students will be able to recognize bacterial shapes and certain protozoa in an identification quiz designed by teacher.

SAMPLE LESSON V: ALGAE AND FUNGI

Course: Biological Science 7

Representative Objective: Classify living things on the basis of observable characteristics.

Skills Emphasized: Speaking, writing, reading, listening.

Thinking/Cognitive Skills: Analysis

1. Specific Objective

   Students will be able to recognize some simple plants.

2. Value to Students

   Students will recognize the differences between simple plants and more complex plants.

3. Initial Instruction/Teacher Presentation

   Teacher introduces students to simple plants through use of lectures, reading assignments, and overhead projections.

   Teacher reviews plant classification.

   Teacher obtains samples of yeast, mushrooms, edible seaweed, and bread and cheese mold.

   Teacher sets up microscopes for observations of bread mold, spirogyra, yeasts, and diatoms.

   Teacher sets up demonstration to show production of carbon dioxide by yeast.

   Teacher prepares a worksheet for students to record their observations of simple plants.

4. Guided Group Practice

   Students observe yeasts, mold, and algae through microscopes. Students bisect mushrooms and identify their structures and also taste edible seaweed.

5. Independent Practice

   Students complete laboratory report describing the structure of algae and fungi.

6. Individual Differences and Learning Modalities

Remediation/alternative activities: Overhead projections or flashcards can be used to review knowledge of fungi and algae. Show film loops or filmstrips about algae and fungi.

Enriched/supplemental activities: Instruct students to make oral or written reports on various types of algae and fungi. Ask students to make poster-sized drawings of fungi and/or algae.

7. Evaluation

Students will be able to recognize various algae and fungi on an identification quiz designed by teacher.

SAMPLE LESSON VI: FLOWER DISSECTION

Course: Biological Science 7

Representative Objective: Employ appropriate scientific instruments for gathering data.

Skills Emphasized: Speaking, writing, reading, listening.

Thinking/Cognitive Skills: Knowledge

1. Specific Objective

   Students will observe and comprehend functions of flower structures.

2. Value to Students

   Students will use tools for dissecting and observing flower structures. Class members will be able to recognize various structures and understand why these structures are important to the plant and to the reproduction process.

3. Initial Instruction/Teacher Presentation

   Teacher introduces the structures of flowers through use of lectures, reading assignments, and audiovisual material.

   Teacher prepares a laboratory sheet for students to use in recording results of their observations.

   Materials Needed

   - Dissection trays
   - Scalpels
   - Dissecting needles
   - Hand lenses
   - Flowers
   - Microscopes
   - Slides

4. Guided Group Practice

   Students dissect flowers, counting numbers of petals and sepals; identify stamens and pistils; examine pollen under the microscope; examine structures with hand lenses; record their observations on laboratory sheet.

5. Independent Practice

   Students are given a class assignment to draw and label flower structures and to determine how a plant uses these structures.

6. Individual Differences and Learning Modalities

Remedial/alternative activities: Additional reading assignments and filmstrips dealing with flower structures and functions may be used.

Enriched/supplemental activities: Instruct students to report on the differences in monocot and dicot flowers or fertilization processes in the flowers or on types of pollination. Ask students to make poster-sized drawings of flowers, with labels indicating the name and function of each structure.

7. Evaluation

Students compare and discuss their observations of flower structures and are given a teacher-designed test on the subject.

SAMPLE LESSON VII: ANIMAL KINGDOM CLASSIFICATION

Course: Biological Science 7

Representative Objective: Students will be able to classify living things on the basis of observable characteristics.

Skills Emphasized: Listening, writing, reading, speaking.

Thinking/Cognitive Skills: Analysis

1. Specific Objective

   Students will be able to recognize the different characteristics of the various phyla of animals.

2. Value to Students

   Students will become aware that different groups of animals have certain characteristics which make them different from other groups.

3. Initial Instruction/Teacher Presentation

   Teacher instructs class about different animal groups, using overhead transparencies, flash cards, or lectures.

   Teacher reviews body structure, symmetry, appendages, body plan, and skeleton type.

   Teacher sets up specimen bottles of the various phyla of animals.

   Teacher provides a chart for students to list characteristics of each phylum. (See attachment.)

4. Guided Group Practice

   Students observe specimen bottles and list their observations.

5. Independent Practice

   Students are given a library assignment in which they are to find the names of twenty or more individual representatives of each phylum and are to explain why each animal is classified in a particular group.

6. Individual Differences

Remedial: Encourage class members to review phyla characteristics and to observe additional specimens. Flash cards, overhead transparencies, or film strips may be used for additional review of phylum names and characteristics.

Enrichment: Instruct students to make a collection of pictures of as many representative members of each phylum as they can find in magazines; ask students also to make a bulletin board display, using phylum names, characteristics, and pictures of animals in the various phyla.

7. Evaluation

Teacher prepares quiz in which students are to name the phylum from a description of the phylum characteristics.

In a practical laboratory exam, students move from station to station, answering questions about specimens on display.

Zoologist: _____

Per. _____ Table _____

THE ANIMAL KINGDOM CHART

Animal group	Scientific name of phylum	Phylum characteristics	Examples of animals
Sponges	Porifera (pore-bearing)		
Jellyfish	Coelenterata (hollow-bodied)		
Flatworms	Platyhelminthes (flat-worm)		
Roundworms	Nematoda (thread)		

Animal group	Scientific name of phylum	Phylum characteristics	Examples of animals
Segmented worms	Annelida (ringed)		
Soft-bodied animals	Mollusca (soft-bodied)		
Spiny-skinned animals	Echinodermata (spiny-skinned)		
Jointed-legged animals	Arthropoda (joint-leg)		
Backboned animals	Chordata (cord)		

Animal: _____

Per._____Table _____

USING THE ANIMAL KINGDOM CHART

1. What is the scientific name for sponges? _____
2. About how many species of sponges are there? _____
3. What group of animals has "pores"? _____
4. What are two characteristics of soft-bodied animals?_____ and _____
5. What does "echinodermata" mean? _____
6. About how many species of soft-bodied animals are there? _____
7. What are three examples of spiny-skinned animals? _____, _____ and _____.
8. About how many species are there of jellyfish and relatives? _____
9. What is the scientific name for flatworms? _____
10. About how many species of worms are there? _____
11. What is the scientific name for spiny-skinned animals? _____
12. About how many species are there of spiny-skinned animals? _____
13. What is the scientific name for soft-bodied animals? _____
14. What is the main characteristic of jellyfish? _____
15. What are the names of three groups of worms? _____

    _____ and _____
16. In what group would you find tapeworms? _____
17. What is the characteristic of segmented worms? _____

    _____
18. In what group would you find the trichina worm? _____
19. What are five examples of soft-bodied animals? _____, _____

    _____, _____, _____, _____
20. What is the scientific name for jellyfish? _____
21. In what group would you find earthworms? _____
22. In what group would you find snails? _____
23. What does coelenterata mean? _____
24. What are three examples of segmented worms? _____,

    _____ and _____

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25. In what group would you find sea urchins? _____

26. What is the scientific name for segmented worms? _____

27. What is the characteristic of flatworms? _____

28. What are the names of three relatives of jellyfish? _____, _____ and _____

29. What is a characteristic of roundworms? _____

30. Which group has the largest number of species? _____

31. What is the scientific name for "backboned"? _____

32. In which group would you find human beings? _____

33. What group has exoskeletons? _____

34. Which group has endoskeletons? _____

35. What is the scientific name for roundworms? _____

36. About how many species are there of backboned animals? _____

37. Which group has the smallest number of species? _____

38. What does chordata mean? _____

39. About how many species are there of joint-legged animals? _____

40. In which group would you find lobsters and shrimps? _____

41. What is the scientific name for jointed-legged? _____

42. What are two examples of flatworms? _____, _____

43. In what group is coral found? _____

44. How many species are there of spiny-skinned animals? _____

45. What does arthropoda mean? _____

46. What are three examples of roundworms? _____, _____ and _____

47. In what group are blood-sucking leeches? _____

48. In what group are squids and octopi? _____

49. What does annelida mean? _____

50. In what group are insects and spiders? _____

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Animal: _____

Per. _____ Table _____

ANIMAL KINGDOM LABORATORY EXERCISES

Instructions: In this laboratory you will observe a variety of organisms belonging to different phyla. Do not shake nor open specimen bottles. Shaking destroys the specimen inside. The liquid in the bottles is formaldehyde, which is poisonous and irritating to the skin. Let your teacher adjust the microscope, if you can't see clearly.

Station One: Phylum Porifera (Pore-Bearing Animals)

1. Animals in Phylum Porifera have bodies covered with _____.
2. Three examples of these animals are: (Write the common name in parentheses on top of specimen bottle.) _____,

   _____, _____
3. The body plan of these animals is (round, flat). _____
4. Do these animals have appendages (arms, legs, etc.)? _____
5. These animals exhibit (radial, bilateral, symmetry). (Circle one.)

Station Two: Phylum Coelenterata (Hollow-Bodied Animals)

1. Animals in Phylum Coelenterata have _____ bodies open at one end.
2. What type of appendages do these animals have? _____
3. Three common examples of these animals are: _____,

   _____, _____
4. The body plan of these animals is _____
5. These animals exhibit _____ symmetry.

Station Three: Worm Phyla

1. The three worm phyla are _____

   _____ and _____
2. Phylum Platyhelminthes includes the _____ worms.
3. Examples of flat worms observed are _____,

   _____ and _____
4. Phylum Nematoda includes _____ worms.
5. An example of a round worm observed is _____

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6. Phylum Annelida includes _____ worms.

7. Examples of segmented worms are _____,

_____, _____

8. Do these worms have appendages? _____

9. The body plan of animals in Phylum Platyhelminthes is

_____

10. The body plan of the other worm phyla is _____

11. All these worms exhibit _____ symmetry.

Station Four: Phylum Mollusca (Soft-Bodied Animals)

1. Members of Phylum Mollusca have _____ usually covered with a _____.

2. Four examples of mollusks observed were: _____,

_____, _____, _____

3. Do any of these mollusks have appendages? If so, which one?

_____. What are these appendages called?

_____

4. The body plan of these mollusks is _____

5. These animals exhibit _____ symmetry.

Station Five: Phylum Echinodermata (Spiny-Skinned Animals)

1. The Echinoderms are animals with _____ skin.

2. Four examples of echinoderms observed were: _____,

_____, _____, _____

3. The body plan of these animals is _____

4. Most echinoderms exhibit _____ symmetry.

5. The starfish and brittle star have appendages called

_____

6. The sea urchin has _____-like appendages.

7. Which echinoderm example appears to be different from the others?

_____

8. The skin of a sand dollar feels _____

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Station Six: Phylum Arthropoda (Joint-Legged Animals)

1. Members of Phylum Arthropoda have _____ legs, and their bodies are covered with an _____ skeleton.
2. An exoskeleton is an _____ skeleton.
3. Ten arthropods observed in the laboratory are: _____, _____, _____, _____, _____, _____, _____, _____, _____, _____.
4. The body plan of arthropods is _____.
5. Arthropods exhibit _____ symmetry.
6. Two types of appendages on arthropods are _____ and _____.
7. Count the pairs of legs on a spider. How many? _____
8. Count the pairs of legs on an insect. How many? _____
9. Count the pairs of legs on a crayfish. How many? _____
10. Which two arthropods have many legs? _____ and _____
11. Name four insect specimens observed in the laboratory: _____, _____, _____ and _____

Station Seven: Phylum Chordata (Back-Boned Animals)

1. Members of Phylum Chordata have _____ and an _____ skeleton.
2. An endoskeleton is an _____ skeleton.
3. Five chordates observed in lab are: _____, _____, _____, _____, _____
4. The body plan of chordates is _____.
5. Chordates exhibit _____ symmetry.

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6. Five kinds of appendages which chordates have are: _____,

_____, _____,

_____, _____

7. Three kinds of body coverings observed were: _____?

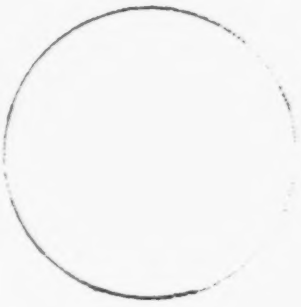
_____, _____

Station Eight: Microscopic Observations

Grantia (sponge)

Phylum:

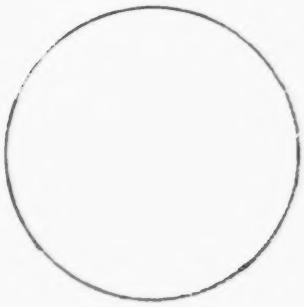
_____



Hydra

Phylum:

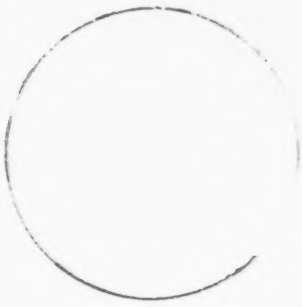
_____



Earthworm

Phylum:

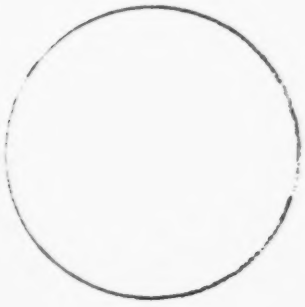
_____



Planaria

Phylum:

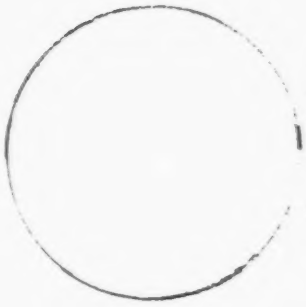
_____



Asterias (Starfish)

Phylum:

_____



Tapeworm

Phylum:

_____

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Anatomist: _____

Per. ___ Table ___

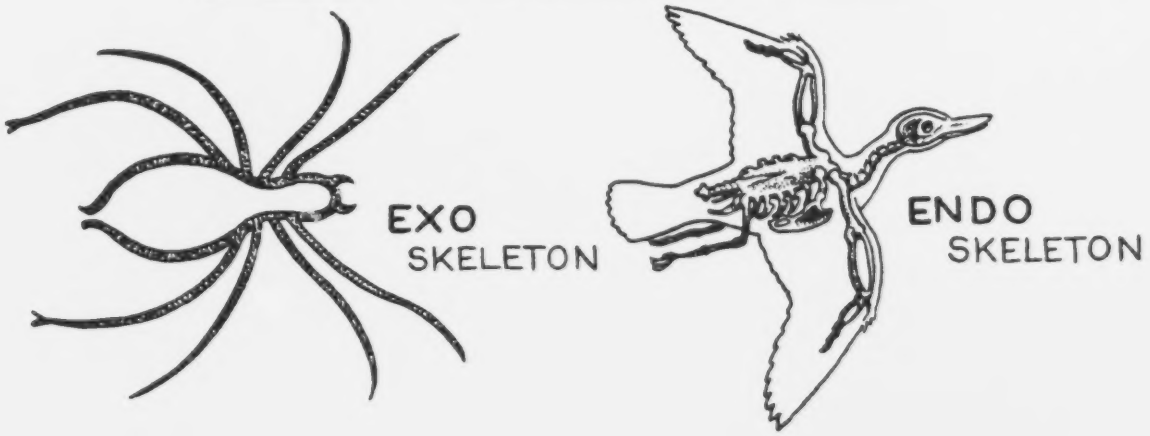
ANIMAL ANATOMY

All living organisms are related, but some organisms are more closely related in structure than others. Anatomy is the science of the structural characteristics of plants and animals. An anatomist is a scientist who studies structure.

As you observe the structure of animal types, these are the characteristics to look for:

1. Body plan: Is the animal round or flat?

2. Skeleton: Does the animal have a skeleton? Is it an outside skeleton (exoskeleton) or an inside skeleton (endoskeleton)?



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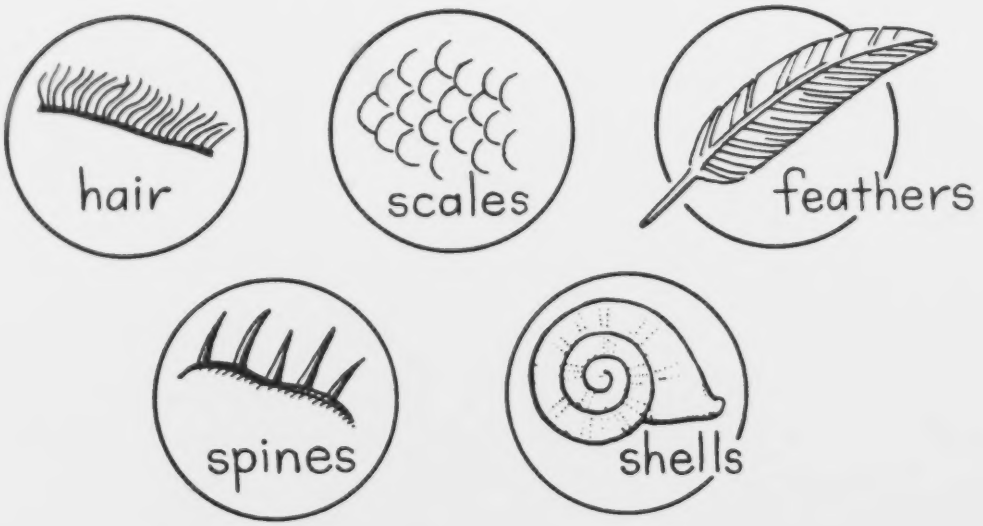
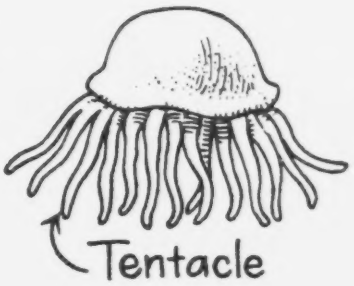
3. Body cover: Is the animal's body covered with hair? Scales? Feathers? Spines? Shell?

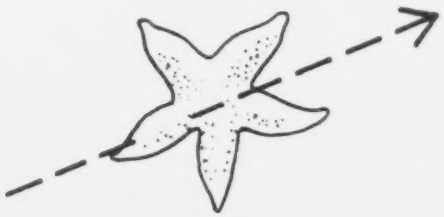


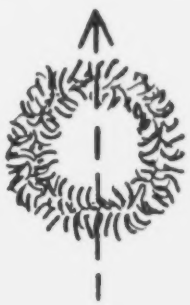
4. Segmentation: Is the animal divided into sections? (Segments)

5. Appendages: Does the animal have appendages? -- Arms, legs, wings, fins, antennae, tentacles?

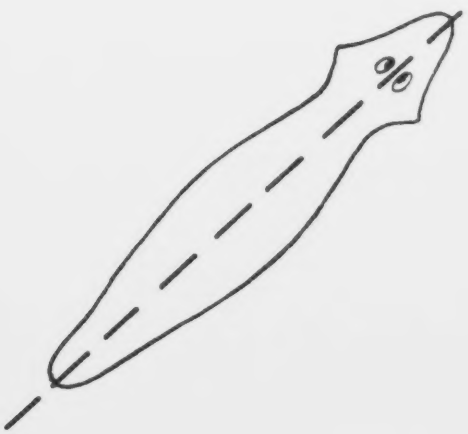


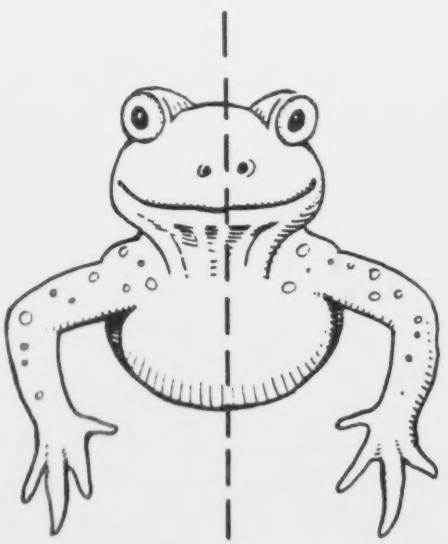
6. Radial symmetry: Are the animal body parts arranged in a circle with no head?





7. Bilateral symmetry: Are the animal body parts arranged so that there is a head and two similar sides?





Name: _____

Period: _____

ANATOMY QUESTIONS

1. _____ is the science of structural characteristics of plants and animals.
2. An _____ is the scientist who studies structure.
3. An animal's _____ _____ is either round or flat.
4. An outside skeleton is called an _____.
5. An inside skeleton is called an _____.
6. Hair, scales, feathers, spines, and shells are called _____.
7. Animals divided into sections have _____.
8. Arms, legs, wings, fins, antennae, tentacles are called _____.
9. Bird appendages are _____ and _____.
10. Fish appendages are _____.
11. Insect appendages are _____and _____.
12. Jellyfish appendages are _____.
13. An animal with body parts arranged in a circle with no head has _____ symmetry.
14. Body symmetry which has a head and two similar sides is _____ symmetry.
15. A starfish has _____ symmetry.
16. Man, frogs, fish, birds have _____ symmetry.
17. Insects, lobsters, crayfish have an _____ skeleton.
18. Human beings, frogs, snakes have an _____ skeleton.

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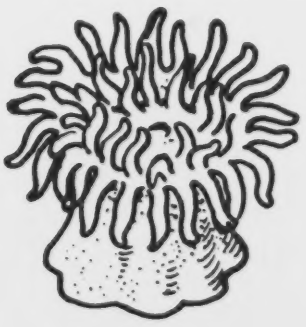


Body plan? _____

Kind of appendages? _____

Type of symmetry? _____

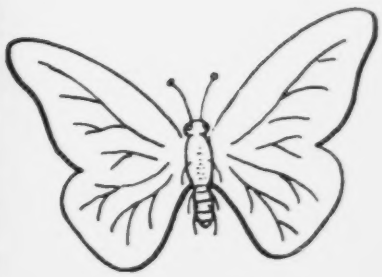
Ape

Type of skeleton? _____

Body cover? _____

Type of appendages? _____ and _____

Type of symmetry? _____



Butterfly

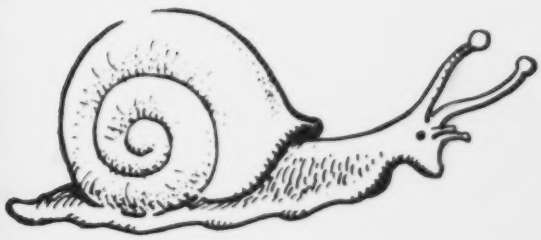
Type of skeleton? _____

Types of appendages? _____ and

_____ and _____

Type of symmetry? _____

Type of body plan? _____

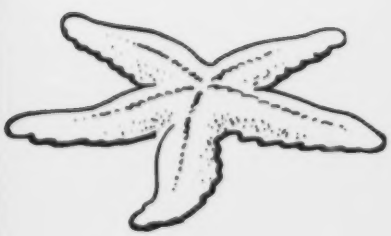


Snail

Type of body plan? _____

Type of appendages? _____

Type of body cover? _____



Starfish

Type of body plan? _____

Type of appendages? _____

Type of body cover? _____

Type of symmetry? _____

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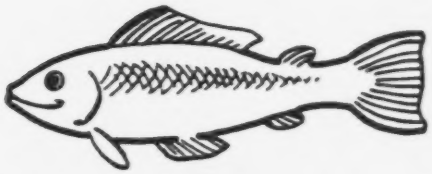
Planaria

Body plan? _____

Symmetry? _____



Fish

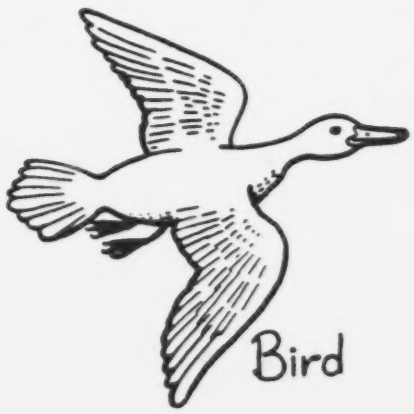
Body plan? _____

Body cover? _____

Skeleton? _____

Appendages? _____

Symmetry? _____



Bird

Body plan? _____

Body cover? _____

Skeleton? _____

Appendages? _____ and _____

Symmetry? _____

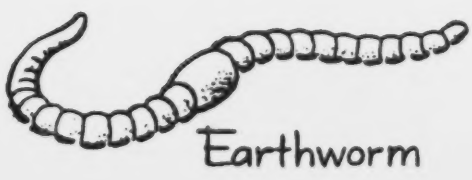
Salamander

Body plan? _____

Skeleton? _____

Appendages? _____

Symmetry? _____



Earthworm

Important anatomical characteristic:

_____

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ANIMAL ANATOMY WORD SEARCH PUZZLE

N	E	D	N	U	O	R	S	E	L	A	C	S
S	O	X	X	S	R	E	H	T	A	E	F	B
E	G	T	O	N	I	F	R	I	A	H	O	S
G	N	A	E	S	L	L	E	H	S	D	P	E
A	I	L	X	L	K	X	X	X	Y	I	L	L
D	W	F	X	X	E	E	X	P	N	G	A	C
N	F	I	S	H	X	K	L	E	X	N	I	A
E	N	O	M	E	N	A	S	E	X	I	D	T
P	A	N	T	E	N	N	A	O	T	W	A	N
P	P	T	N	E	M	G	E	S	D	O	R	E
A	L	A	R	E	T	A	L	I	B	N	N	T
X	N	O	I	T	A	T	N	E	M	G	E	S

Directions: Find the word in the puzzle and circle it.

ROUND
FLAT
EXOSKELETON
ENDOSKELETON
BODY PLAN
SCALES
FEATHER
SHELLS
SPINES
HAIR
APPENDAGES
FIN
WING
ANTENNA
TENTACLE
RADIAL
BILATERAL
SEGMENT
ANEMONE
FISH
SEGMENTATION

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Add letters in the following spaces to form words:

1. _ _ _ _ ME _ _ _ _ _ _ _ _
2. B _ _ _ _ _ _ _ N
3. _ X _ _ _ _ _ _ _ _ _ _
4. _ PP _ _ _ _ _ _ _ _
5. _ _ L _ _ _ _ _ _ _
6. _ _ D _ _ _
7. _ _ _ T
8. _ _ _ _ D
9. _ _ I _
10. _ _ _ NE _
11. _ E _ T _ _ _
12. _ H _ _ _ _
13. _ _ N
14. _ _ _ _ NN _
15. _ _ G _ _ _ _
16. _ E _ _ _ _ _ E
17. _ _ _ O _ _ _ _ _ _ ON

SAMPLE LESSON VIII: HEREDITY IN THE CLASSROOM

Course: Biological Science 7

Representative Objective: Recognize the normal condition of the human organism and develop an appreciation of homeostasis.

Skills Emphasized: Speaking, writing, reading, and listening.

Thinking/Cognitive Skills: Comprehension.

1. Specific Objective

   Students will be able to identify some dominant and recessive traits in humans.

2. Value to Students

   Students gain an understanding of hereditary traits, which are passed from parents to offspring.

3. Initial Instruction/Teacher Presentation

   Teacher discusses the work of Gregor Mendel and his contributions to the study of genetics.

   Teacher introduces the concept of dominant and recessive traits in animals and plants by use of lecture, discussion, or a text assignment.

   Teacher obtains PTC paper and prepares a worksheet for student observations.

   Teacher-designed worksheet should include various observable traits, such as tongue rolling, tasting PTC paper, eye color, ear lobes, hair color, and height.

4. Guided Group Practice

   Students work in pairs and record their observations on the worksheet. Students compile a class record of traits observed. During class discussion under teacher direction, class members decide which traits must be dominant and which are recessive.

5. Independent Practice

   Students are given an assignment in which they list members of their families and indicate observable hereditary traits of each member.

6. Individual Differences/Learning Modalities

Remediation/alternative activities: Students who do not grasp the concepts of hereditary traits may be given additional reading assignments or may work with students who do understand the concepts. Filmstrips on the subject may be available.

Enrichment/supplemental activities: Students may construct a family tree, selecting one or more of the traits discussed in this class activity. Students may be assigned to make a library report on the work of Gregor Mendel.

7. Evaluation

Students participate in a discussion of their particular inherited traits and those of the majority of the class, and write an essay explaining the concept of dominant and recessive traits.

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SAMPLE LESSON IX: ECOLOGICAL BIOMES

Course: Biological Science 7

Representative Objectives: Describe examples of humankind's dependence upon natural ecosystems.

Skills Emphasized: Speaking, reading, writing, listening

Thinking/Cognitive Skills: Comprehension and Analysis

1. Specific Objective

   Students will recognize how temperature and the amount of rainfall determine biomes.

2. Value to Students

   Students will be able to recognize the factors which determine a biome and why certain types of organisms live in these biomes.

3. Initial Instruction/Teacher Presentation

   Teacher introduces ecosystems and biomes by lecture or reading assignments.

   Teacher prepares a chart listing the monthly temperatures (in degrees Celsius) and the monthly rainfall (in centimeters) of two or more hypothetical biomes.

4. Guided Group Practice

   Using the chart, students calculate the average yearly temperature and the average yearly rainfall. Based on this information about the biome, they determine the name of the biome, soil type, and plant and animal representatives.

5. Independent Practice

   Students are given a class or library assignment to list the major biomes and their characteristics.

6. Individual Differences and Learning Modalities

   Remediation/alternative activities: Students are assigned additional reading material and helped by students who understand the concepts of ecosystems and biomes.

Enriched/supplemental activities: Students give oral or written reports on the major biomes. Class members make posters or collections of pictures of animals and plants which survive in the various major biomes.

7. Evaluation

Students will demonstrate recognition of the various c imatic influences on biomes in discussions and on a teacher-designed test.

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TEACHING STRATEGIES

A variety of instructional strategies can enhance the students' growth in concept and skill development. Examples of these instructional strategies include:

- Teacher-directed lesson with the class investigating the same problem.

- Teacher demonstration with the class observing and recording observations and data.

- Independent study. Students conduct independent research and study concept or process areas. When completed, such individual work provides a basis for class learning projects.

- Team learning situations wherein two to four students function together as a laboratory investigation group. Interaction within and among groups acts both as a stimulus and an information-sharing aid to learning.

- Grouping of lower-achieving students with those achieving at a higher level. This permits peer tutoring and interaction which can benefit the less motivated individuals.

- Contract between student and teacher which outlines and prescribes specific tasks to be performed by the student for the fulfillment of certain course requirements.

- Self-paced learning designed for mastery. Assessment is conducted as each student concludes each unit, and the results indicate whether a student is ready to advance to the next unit or experience--a repeated opportunity for the instructor to use a new strategy. Student's mark is based on number of units mastered.

- Library research studies wherein many of the principles learned in laboratory and class activities can be applied to a class, small group (team), or individual project.

- Class presentations by individual or laboratory teams on the outcomes of laboratory investigations which are shared with the class.

- Design and formulation of research projects. Individuals or teams apply the methods, materials, and techniques learned to a real experimental investigation.

HIGHER LEVELS OF THINKING

Because questioning is the primary tool in achieving educational goals, teachers will want to be sure their questions are appropriate for the ability level of students and challenge students to higher levels of thinking.

Bloom classifies six levels of thinking. They are:

- Knowledge (recognition or recall of previously learned material)
- Comprehension (translation or interpretation of data)
- Application (application of past learnings to a new situation)
- Analysis (emphasis on the breakdown of material into constituent parts, the detection of relationships, and the organization of parts)
- Synthesis (organization of separate elements in a new creative structure)
- Evaluation (arrival at value judgments about a material or work)

The levels of thinking are sequential. In other words, each category of thinking is different and builds on lower categories. The categories are arranged from simple to complex and from concrete to abstract.

It is important that all students have many opportunities to answer questions involving every level of thinking. Within each category of thinking there are both simple and complex questions for slow and for rapid learners.

Questioning is particularly important during guided group practice in the teacher-directed lesson. Carefully constructed questions using various levels of thinking will help the teacher determine the students' comprehension of new material and assess their readiness to move on to independent practice. Individualization of instruction and remedial or alternative work can be achieved by constructing questions of varying levels of complexity.

Verbs alone do not necessarily determine the level of thinking. A given question may not represent the same task to all students. What may be an analysis question to one student may be a knowledge question to a pupil who has already read and received an explanation of the material. The level of a question depends on how much information the student has already received. If a student is expected to answer a "why" or "how" question by restating an answer provided in the textbook or from the teacher's lecture, the level of thinking is knowledge. If, however, the student has to figure out the answer, not simply remember it, the student is working on a higher level of thinking, such as analysis, synthesis, or evaluation.

Benjamin S. Bloom: Taxonomy of Educational Objectives: The Classification of Educational Goals, Handbook I: Cognitive Domain (Longman Inc., New York, 1956).

Six categories of thinking and suggested verbs for teachers are provided on the following page. Teachers will find these helpful in constructing questions and planning lessons. For further classification of learning levels in the affective and psychomotor domains, teachers are referred to Reaching Higher Levels of Thought, Los Angeles Unified School District, Office of Secondary Instruction; Publication No. X-118, 1982.

MAJOR CATEGORIES AND SOME POSSIBLE VERBS FOR USE IN STATING COGNITIVE OUTCOMES

KNOWLEDGE	COMPREHENSION	APPLICATION	ANALYSIS	SYNTHESIS	EVALUATION
define	translate	interpret	distinguish	compose	judge
repeat	restate	apply	analyze	plan	appraise
record	discuss	employ	calculate	propose	evaluate
list	describe	use	experiment	design	rate
recall	recognize	demonstrate	test	formulate	revise
name	explain	dramatize	compare	arrange	score
relate	express	practice	contrast	assemble	assess
underline	identify	illustrate	criticize	collect	estimate
	locate	operate	diagram	construct	choose
	report	schedule	inspect	create	measure
	review	shop	debate	set up	select
	tell	sketch	inventory	organize	value
			question	manage	
			relate	prepare	
			solve		
			examine		
			categorize		

EVALUATION PROCEDURES

The evaluation of instruction is an integral part of the education process. It provides information on what has been accomplished and where to go next. The first phase of evaluation should be diagnostic. The teacher should assess what students know before instruction begins, and then plan an appropriate course based on students' knowledge and abilities. In addition to diagnostic pretesting, ongoing evaluation during instruction provides teachers with a record of student progress and indicates the instructional changes that may have to be made in order to plan for maximum achievement. Post-testing is used to assess how well students have met the objectives at the end of the unit or course. The Secondary Science Continuum provides teachers with a basis for the development of instructional objectives.

The selection or construction of appropriate instruments of evaluation is critical to the measurement process. Test items must measure and reflect instructional objectives. Tests of achievement and problem-solving skills often require advanced reading skills. Therefore, it is recommended that diagrams, graphs, and pictures also be used to evaluate student progress and achievement.

Various measures of evaluation can be used in all phases of science education. Achievement tests are used to assess science knowledge and comprehension. Problem-solving measures are useful in determining higher cognitive skills, such as analysis, synthesis, and evaluation. Motor skills and skill in the application of scientific knowledge can be evaluated in the laboratory setting. Observations and interview techniques are useful in the assessment of such laboratory skills as manipulation of materials, setting up experiments, handling and caring for live specimens, and employing safety practices. These measurement techniques allow for immediate feedback to students.

Suggested assessment procedures include the following: teacher-prepared tests; commercially prepared tests; departmental tests; informal and formal assessment of individual and group activities in oral work and discussion; and student-prepared test items, which provide reinforcement and the opportunity to apply course content.

TIPS FOR PARENTS

There are many ways in which parents can provide the proper guidance, motivation, assistance, and a nurturing home environment that will contribute to their youngster's success and learning in science.

1. Show an active interest in your youngster's science learning activities. Take notice of and respond to science-related conversations, books, and magazine and newspaper articles.

2. Be an observer. Offer assistance with a statement like, "We can discover by observation." This will stimulate and help your youngster to understand how knowledge develops through observation, thought, explorations, and verification.

3. Be a good listener, and discuss science interests and questions. This will help you learn more about your youngster's interests, thinking and reasoning abilities, and attitudes.

4. Read, review, and discuss homework and other class assignments.

5. Share experiences. For example, if you are an amateur gardener, a mechanically inclined person, or a rock and mineral collector, you have something to share and to contribute to your youngster's developing curiosity about scientific interests.

6. Learn together. Encourage questions. Help your youngster locate sources of information and plan activities that provide opportunities for observing, experimenting, and recording data and the results of experimentation.

7. Practice scientific skills and attitudes. For examples, help your youngster learn to withhold judgments until sufficient evidence has been secured, to challenge sources of information, and to be open-minded. These efforts will lead students toward the attainment of productive scientific attitudes.

8. Provide a quiet work and study area which can be used for preparing homework, studying, developing collections, experimenting, and making things.

9. Provide materials for learning, such as science-related books and magazines. Not only do they help students answer questions, but they also provide opportunities to experience the satisfaction of independent discovery.

10. Plan visits to museums, science fairs, observatories, zoos, national parks, open houses at universities, industry and governmental agencies, and other places of scientific interest.

11. Discuss with the teacher your youngster's progress and the specific learning needs which can be met through home study and how your youngster might receive individualized help if needed.

12. Consult with the teacher and librarian about the selection of science-related books, magazines, and other materials available for reading. Become familiar with some of the science apparatus, displays, books, audiovisual materials, and other instructional resources used by the school.

13. Learn about the school's science program. Parental support of the school program is an essential factor in shaping positive attitudes toward education.

APPENDICES

APPENDIX A: RESOURCES

A Collection of Selected Goals and Objectives. Los Angeles Unified School District: Office of Instruction.

A Statement of Goals. Los Angeles Unified School District: Office of Instruction, Publication No. GC-31, 1975.

Administrative Directives and Curricular Information. Los Angeles Unified School District: Office of Instruction, Publication No. SC-769. Stock No. 461260, 1984.

Audiovisual Materials Resource List, Secondary Schools Edition. Latest Revision. Los Angeles Unified School District: Audiovisual Services Section.

Catalog of Standard Equipment for Elementary, Secondary and Adult Schools. Latest Revision. Los Angeles Unified School District: Purchasing Branch.

Catalog of Films for Secondary and Adult Levels. Latest Revision. Los Angeles Unified School District: Audiovisual Services Section.

Guidelines for Assignment of Homework for Elementary and Secondary Schools. Los Angeles Unified School District: Office of Instruction, Publication No. GC-67, 1978. 16 pp.

Guidelines for Instruction, Science, Secondary School Curriculum. Los Angeles Unified School District: Office of Instruction, Publication No. SC-769.19. 1984.

Instructions for Teachers on the Assessment of the Secondary Science Continuum, Grades 7-12, for Junior and Senior High Schools, 1980-81. Los Angeles Unified School District: Office of Instruction, Publication No. SC-795, 1980.

Junior High School General Science Continuum Assessment, Version 2. Los Angeles Unified School District: Instructional Planning Division, 1980.

List of Authorized Textbooks, Junior and Senior High Schools and Community Adult Schools. Latest Revision. Los Angeles Unified School District: Textbook Services Section, Publication No. 426.

List of California State Series Textbooks and Prepared Instructional Materials. Latest Revision. Los Angeles Unified School District: Textbook Services Section.

Marking Practices and Procedures for Elementary and Secondary Schools. An Instructional Bulletin. Los Angeles Unified School District: Office of Instruction, Publication No. CG-74, 1978. 62 pp.

Metrics (SI) for the Secondary Classroom. Los Angeles Unified School District: Office of Instruction, Publication No. SC731, 1976. 186 pp.

Ordering Secondary Science Continuum Assessment Instruments and Support Materials. Latest Revision. Los Angeles Unified School District: Office of Instruction.

Putting Critical Thinking to Work. Los Angeles Unified School District: Office of Instruction, Publication No. EC-501. Stock No. 463180.

Reaching Higher Levels of Thought. Los Angeles Unified School District: Office of Instruction, Publication No. X-118. Stock No. 463320.

Safety and Workers Compensation Reference Guide. Los Angeles Unified School District, 1980. Sections 2370-45 through 2370-54.

Science. Los Angeles Unified School District: Office of Instruction, Publication No. SC-769. Stock No. 461278.

Science Materials Center Catalog and Loan Equipment List for Secondary Schools, Order Forms, and Other Information. Annually Revised. Los Angeles Unified School District: Office of Instruction.

Study Center Activity Cards. Los Angeles Unified School District: Office of Instruction, Publication No. GC-32. Stock No. 463640.

Suggested Terminal Objectives: Science, Junior and Senior High Schools. Examples of instructional objectives, together with samples of pre- and post-test items. Los Angeles Unified School District: Office of Instruction, Publication No. SC-711. 76 pp.

Teaching the Essential Skills. Los Angeles Unified School District: Office of Instruction, Publication No. GC-82. Stock No. 463818.

Test-Taking Procedures and Techniques for Secondary Schools. Los Angeles Unified School District: Office of Instruction, Publication No. X-116. Stock No. 463897, 1982.

The Teaching of Values. Los Angeles Unified School District: Office of Instruction. Publication No. GC-56. Stock No. 463810.

Use Metric! Activities to Help Parents Get the "Feel" of SI Metric Units of Measure. Revision. A Teacher's Guide. Los Angeles Unified School District: Office of Instruction, Publication No. SC-726, 1979.

We Tried It. We Liked It. Los Angeles Unified School District: Office of Instruction. Publication No. GC-77 Stock No. 464415.

APPENDIX B: SECONDARY SCIENCE CONTINUUM

INTRODUCTION TO THE SCIENCE CONTINUUM, GRADES 7-12

PURPOSES

Science is the discipline which involves the acquiring and organizing of knowledge to explain natural phenomena and to increase their usefulness to humankind. Through the science instructional program in secondary schools, students develop an understanding that science is a body of knowledge comprised of interconnected sets of principles, laws, and theories that explain the known universe and our relationship to it. Students use learning processes to systematically investigate phenomena and acquire and refine information. Outcomes include understanding how human beings use scientific information and discoveries to comprehend and practice the pursuit of objective knowledge as a source of truth.

COMPONENTS

The Science Continuum encompasses the four competency strands of attitudes, thinking processes, skills, and knowledge. Within each strand, the continuum includes objectives and the kinds of performance necessary for the student to achieve each objective. However, the continuum does not limit the scope of the science curriculum. Teachers should encourage students to progress to the extent of their interests and abilities. In the continuum, certain symbols are used. Items with a solid dot identify the expectancy level for all students. Those items without dots identify levels above those expected for all students. An open circle in the K-6 column indicates that certain items are first introduced to the student in elementary school.

Attitudes Strand. This strand emphasizes the development of values, aspirations, and attitudes which promote the personal involvement of the individual with the environment and society. The attitudes listed relate to what is hoped students will accomplish, individually, through self-motivation, as a result of science instruction. Positive attitudes toward science and learning are prerequisites to effective learning in other strands.

Objectives of the attitudes strand include the ability of the learner to: internalize scientific attitudes; establish the personal and social relevance of what has been learned about science, scientists, and society; and enjoy and appreciate science.

Thinking Processes Strand. The goal is to help the student develop and apply rational and creative thinking processes. As defined here, these processes refer to the cognitive techniques involved in scientific inquiry as well as those basic to all rational thinking. Such processes as observing, measuring, comparing, and classifying lead to more sophisticated processes, such as inferring, generalizing, and theorizing.

Skills Strand. The goal is to help the student develop and use fundamental skills in the manipulation of materials and equipment, in caring for and handling living organisms, and in gathering, organizing, and communicating information relating to science. Various skills are utilized when the student employs thinking processes to develop a conceptual understanding of the natural environment and collects information through observation, manipulation of materials and apparatus, reading, listening, use of measuring instruments, and handling of living organisms. He or she employs linguistic, mathematical, graphical, and tabular skills in recording and organizing information.

A major goal of science education is the provision of opportunities for learners to develop and use these manipulative and communicative skills. Many areas of the curriculum relate closely to the skills that are critical to science education. Reading, writing, speaking, and listening skills are all basic to the communication needs of science students. Many of the skills described in the section are essential in a broad spectrum of occupations. For example, people in almost every occupation must be able to obtain, record, process, interpret, and report information and to communicate ideas in a clear, convincing manner. The skills goal is not only critical to science education, but it is also important in the development of competencies necessary for effective citizenship.

Knowledge Strand. The goal is to assist the student in developing knowledge of processes, facts, principles, generalizations, and applications -- the products of science -- and to encourage their use in the interpretation of the natural environment. Acquisition of organized knowledge is a long-range goal of science and science education. Through an understanding of contributing facts, unifying principles, and relevant processes, organized knowledge gradually takes on meaning for the learner. He or she will acquire some knowledge as a by-product of instruction intended to develop attitudes, skills, and thinking processes and will acquire other knowledge as a deliberate result of instruction. At all levels, the knowledge goal must be in balance with and consistent with the other goals of science education.

Four types of knowledge can be highlighted as components of this goal: (1) knowledge that enables the learner to communicate the thinking processes and skills of science; (2) knowledge that constitutes broad generalizations which interrelate the many facts, concepts, and principles of all the sciences; (3) knowledge of how science and technology affect society; and (4) knowledge that constitutes the content, basic concepts, and structure of the major disciplines in science.

IMPLEMENTATION

Through the in-service process, the teacher should become fully cognizant of the Science Continuum, its rationale, and its possible use. The goals and objectives of the continuum are basic to all science courses and are consistent with the provisions of AB 65 and the forthcoming State Science Framework. District-developed pretests and posttests are planned to assist teachers in evaluating each student's level of achievement in relation to the Science Continuum. The results of pretests should be used in planning instruction to meet more effectively group and individual needs. In addition, the teacher should formulate a variety of ways to assist the student needing additional instruction.

Approaches to instruction may include:

Development of learning centers
Assignment to independent study projects
Improvement of classroom management

Use of additional instructional resources
Introduction of changes in organization within the science department; e.g., use of minicourses, team teaching
Expansion of tutoring program
Improvement of counseling

Pretests and other tests prepared by the teacher should:

Be used to evaluate continuum goals and learner performance objectives.
Consist only of items based on performance objectives expected of all students.
Assess understanding of science concepts rather than reading ability.
Avoid items which are of a controversial nature with respect to individual religious or political beliefs.
Relate to life situations common to individuals in all cultural groups.
Involve problem statements with supporting data, as expressed in graphs, tables, pictorials, and other illustrations.
Wherever possible, relate items from skills, thinking processes, and attitudes objectives to knowledge objectives.

Test items related to attitudes should give the learner an opportunity to utilize knowledge applicable to the appropriate scientific attitude. This may or may not reflect the learner's personal attitude.

Test items related to thinking processes should be based on hypothetical problem-solving experiments and include questions that assess the student's understanding of scientific methods.

Test items related to skills should include questions about science apparatus, rules of safety, materials, and equipment common to both biological and physical sciences. Illustrations should be included.

SCIENCE CONTINUUM
GRADES 7-12

SYMBOLS
- ---- = Awareness/Exposure
- 0 = Introduction/Development
- ● = Assessment/Evaluation
- —— = Maintenance/Reinforcement

1.0.0 ATTITUDES

		K	6	7	8	9	10	11	12
1.1.0	SHOWS CURIOSITY ABOUT OBJECTS AND EVENTS.								
1.1.1	Shows willingness to examine and organize objects and events in the environment.	0			●		●		
1.2.0	RECOGNIZES AND REPORTS EVIDENCE OF ORDER AND SYMMETRY IN THE ENVIRONMENT.								
1.2.1	Relates classification to everyday life situations.	0			●		●		
1.3.0	APPRECIATES AND RESPECTS ALL LIVING ORGANISMS, INCLUDING SELF AND HIS/HER RELATIONSHIP TO THE ENVIRONMENT.								
1.3.1	Accepts responsibility for the care of living organisms in natural and artificial environments.	0			●		●		
1.3.2	Appreciates the interdependence of living organisms in the natural environment and the implications for continued survival.	0			●		●		
1.4.0	TAKES AN ACTIVE ROLE IN SOLVING SOCIAL PROBLEMS RELATED TO SCIENCE AND TECHNOLOGY.								
1.4.1	Practices conservation in use of food, energy, and materials.	0			●		●		
1.4.2	Develops and expresses an opinion on a social issue.	0							
1.4.3	Seeks to influence the views and behaviors of others with respect to social issues related to science and technology.								
1.5.0	WEIGHS ALTERNATIVE SCIENTIFIC, ECONOMIC, PSYCHOLOGICAL, OR SOCIAL FACTORS WHEN CONSIDERING POSSIBLE SOLUTIONS TO SOME PROBLEMS.								
1.5.1	Recognizes the alternative factors to be considered when examining possible solutions.	0			●		●		
1.5.2	Examines a variety of alternative viewpoints on scientific issues to form opinions about them.								

ATTITUDES (CONT.)

		K-6	7	8	9	10	11	12
1.6.0	ORGANIZES AND REPORTS THE RESULTS OF SCIENTIFIC INVESTIGATIONS IN AN HONEST AND OBJECTIVE MANNER.							
1.6.1	Understands the need to log only those data he/she has actually gathered.	o		•		•		
1.6.2	Forms opinions only after seeking a variety of data and ideas.			•		•		
1.6.3	Assumes responsibility for reporting results in an honest and objective manner.	o		•		•		
1.7.0	HAS A CRITICAL, QUESTIONING ATTITUDE TOWARD INFERENCES, HYPOTHESES, AND THEORIES.							
1.7.1	Shows an interest in responding to contradictions between data and theory.							
1.8.0	APPLIES RATIONAL AND CREATIVE THINKING PROCESSES WHEN TRYING TO FIND RELATIONSHIPS AMONG SEEMINGLY UNRELATED PHENOMENA AND WHEN SEEKING SOLUTIONS TO PROBLEMS.							
1.8.1	Attempts spontaneously to describe an object or event that has attracted his/her attention.	o		•		•		
1.8.2	Applies science problem-solving techniques in everyday life situations.	o		•		•		
1.9.0	RECOGNIZES THE VALUES OF SCIENCE AS A HUMAN ENDEAVOR REPRESENTING ALL RACIAL, ETHNIC, AND CULTURAL BACKGROUNDS.							
1.9.1	Chooses to gather information and report on the contributions of all cultures to the scientific world.	o		•		•		
1.9.2	Acknowledges that race, sex, or nationality should not constitute a barrier to scientific study.	o		•		•		
1.9.3	Values the scientific contributions of human beings from varying cultural backgrounds.	o		•		•		

ATTITUDES (CONT.)

		K-6	7	8	9	10	11	12
1.10.0	CONSIDERS SCIENCE RELATED CAREERS AND MAKES REALISTIC DECISIONS ABOUT PREPARING FOR SUCH CAREERS, TAKING INTO ACCOUNT ABILITIES, INTERESTS, AND PREPARATION REQUIRED.							
1.10.1	Values the abilities, interests, and preparation required for a science-related career.			•		•		
1.10.2	Assumes responsibility for making a realistic decision about the pursuit of a science-related career.							

2.0.0 THINKING PROCESSES

		K-6	7	8	9	10	11	12
2.1.0	DEVELOPS ABILITY TO GENERATE DATA BY OBSERVING, RECALLING, RECOGNIZING, IDENTIFYING, AND MEASURING.							
2.1.1	Examines objects carefully, using a combination of senses to collect and process data; derives meaning from the observation; recognizes the need to use simple instruments to aid the senses in collecting data.	o		•		•		
2.1.2	Determines the need to repeat observations as a means of improving reliability.	o		•		•		
2.1.3	Uses measurement procedures to improve accuracy of observations.	o		•		•		
2.1.4	Identifies changes in properties and rates of change.	o						
2.2.0	DEVELOPS ABILITY TO ORGANIZE DATA BY COMPARING, CLASSIFYING, RELATING, AND ORDERING.							
2.2.1	Perceives similarities and differences in a set of objects; separates a set into groups according to a single characteristic.	o		•		•		
2.2.2	Develops arbitrary classification systems wherein objects can be put into mutually exclusive categories, uses quantitative measurements as criteria for grouping.							

THINKING PROCESSES (CONT.)

		K-6	7	8	9	10	11	12
2.3.0	DEVELOPS ABILITY TO APPLY AND EVALUATE DATA AND GENERATE THEORIES BY HYPOTHESIZING, PREDICTING, INFERRING, GENERALIZING, THEORIZING, EXPLAINING, JUSTIFYING, JUDGING, AND INTERPRETING.							
2.3.1	Examines environmental issues, pointing out contradictions and discrepancies in the positions of various groups.							
2.3.2	Gathers own data to form own point of view, satisfying any former contradictions.	0						
2.3.3	Recognizes contradictions and unusual events.							
2.3.4	Designs experiments to produce specific data to support or refute a hypothesis.							
2.4.0	PARTICIPATES IN SCIENTIFIC INQUIRY AT THE APPROPRIATE LEVEL.							
2.4.1	Defines a problem related to an unusual event.							
2.4.2	Identifies data needed to test a hypothesis; designs an experiment to generate the data; records and organizes data; and evaluates the hypothesis in light of new data.							

3.0.0 SKILLS

		K-6	7	8	9	10	11	12
3.1.0	ASSEMBLES AND USES LABORATORY APPARATUS, TOOLS, AND MATERIALS IN A SKILLFUL MANNER, GIVING DUE ATTENTION TO SAFETY MEASURES.							
3.1.1	Manipulates simple materials, apparatus, and equipment in a safe manner.	0		•		•		
3.1.2	Demonstrates growth in the ability to manipulate more complex science materials and equipment.			0		•		
3.1.3	Acquires and assembles appropriate science apparatus, materials, and equipment in order to obtain designated data.							

SKILLS (CONT.)

		K-6	7	8	9	10	11	12
3.2.0	DEMONSTRATES PROPER TECHNIQUES FOR HANDLING AND CARING FOR LIVING ORGANISMS.							
3.2.1	Handles plants and animals carefully, following suggested procedures.	0		•		•		
3.2.2	Provides an environment for plant and animal life that is conducive to the support of normal life functions.	0		•		•		
3.3.0	GATHERS THE INFORMATION NEEDED FOR DEVELOPING OR TESTING INFERENCES AND HYPOTHESES BY MAKING PURPOSEFUL, OBJECTIVE OBSERVATIONS OF THINGS AND EVENTS.							
3.3.1	Makes purposeful, objective observations.	0		•		•		
3.3.2	Determines the timing of a series of events.							
3.4.0	GATHERS NEEDED INFORMATION, WHICH HAS BEEN GENERATED BY OTHERS, FROM A VARIETY OF SOURCES APPROPRIATE TO HIS/HER ABILITY LEVEL.							
3.4.1	Listens to the ideas of others.	0		•		•		
3.4.2	Gathers information from science textbooks, reference materials, science films, and television.	0		•		•		
3.4.3	Finds sources of information needed to solve a problem related to a specific topic.	0		•		•		
3.5.0	RECORDS OBSERVATIONS ACCURATELY AND ORGANIZES DATA AND IDEAS IN WAYS THAT IMPROVE THEIR USEFULNESS.							
3.5.1	Orally describes a series of events that have taken place.	0		•		•		
3.5.2	Tabulates information and uses tables.							
3.5.3	Interprets graphs and displays data graphically.	0						
3.6.0	COMMUNICATES WITH OTHERS IN A MANNER THAT IS CONSISTENT WITH KNOWLEDGE.							
3.6.1	In group settings, orally describes observations and answers questions.	0		•		•		
3.6.2	Explains, either orally or in writing, the methods and procedures involved in carrying out an investigation.	0						

SKILLS (CONT.)

		K-6	7	8	9	10	11	12
3.7.0	USES THE METRIC SYSTEM EFFECTIVELY.							
3.7.1	Counts, uses numbers, and balances objects on an equal-arm balance scale.	0		•		•		
3.7.2	Measures linear distances, using a metric ruler.	0		•		•		
3.7.3	Uses a balance to determine the mass of objects.	0				•		
3.7.4	Measures volume of liquids in a graduated cylinder marked in metric units.							
3.8.0	APPLIES APPROPRIATE MATHEMATICAL CONCEPTS AND SKILLS IN INTERPRETING DATA AND IN SOLVING PROBLEMS.							
3.8.1	Calculates rates from data.							
3.8.2	Finds the mean and median of a series of measurements.							
3.8.3	Utilizes exponential notation to express very large and very small numbers.							
3.8.4	Determines degree of precision of measurement and quantities derived from measurements.							
3.8.5	Uses calculators and/computers to advantage in manipulating data and solving problems.							

4.0.0 KNOWLEDGE

		K-6	7	8	9	10	11	12
4.1.0	DEMONSTRATES KNOWLEDGE OF THE PROCESSES OF SCIENTIFIC INQUIRY.							
4.1.1	Distinguishes between trial and error and controlled investigations.	0		•		•		
4.1.2	Matches names of various processes and products of scientific inquiry with examples.							
4.1.3	Evaluates procedures in the inquiry process that have been omitted or inadequately performed.							

KNOWLEDGE (CONT.)

		K-6	7	8	9	10	11	12
4.2.0	DEMONSTRATES UNDERSTANDING OF BASIC GENERALIZATIONS, RELATIONSHIPS, AND PRINCIPLES.							
4.2.1	Identifies simple cause effect relationships.	0		•		•		
4.2.2	Uses a cause-effect relationship to make a prediction.	0						
4.2.3	Recognizes that atoms are composed of electrons, protons, neutrons, and other particles.	0				•		
4.2.4	Recognizes that electrons are negatively charged and protons are positively charged.					•		
4.2.5	Illustrates that the number of atomic particles varies with each element.					•		
4.2.6	Recognizes that matter is composed of particles which are in constant motion.					•		
4.2.7	Describes interaction and reorganization of units of matter and their association with changes of energy.							
4.2.8	Recognizes the uses of fuels.	0		•		•		
4.2.9	Identifies examples of kinetic and potential energy.					•		
4.2.10	Identifies pairs of objects having similar properties.	0		•		•		
4.2.11	Describes systems of classification used to sort a group of miscellaneous objects.	0		•		•		
4.2.12	Recognizes that classification systems are developed by humans for the use of humans and are one way of helping to understand the basic organization and pattern of nature.			•		•		
4.3.0	DEMONSTRATES KNOWLEDGE OF RELATIONSHIPS BETWEEN SCIENCE AND SOCIETY.							
4.3.1	Gives examples of ways in which the use of scientific knowledge has affected society.	0		•		•		
4.3.2	Describes aspects of a society that tend to encourage or inhibit the advancement of science.							
4.3.3	Identifies types of data valuable in planning environmental changes.							

KNOWLEDGE (CONT.)

		K-6	7	8	9	10	11	12
4.4.0	DEMONSTRATES KNOWLEDGE OF SCIENCE-RELATED CAREER OPPORTUNITIES AND THE PREPARATION NEEDED.							
4.4.1	Compares the work performed by persons in science occupations.	0						
4.4.2	Identifies ways in which careers are science related.	0						
4.5.0	DEMONSTRATES KNOWLEDGE OF CONTRIBUTIONS TO SCIENCE AND TECHNOLOGY MADE BY MEN AND WOMEN OF VARIOUS RACES AND NATIONALITIES.							
4.5.1	Matches significant discoveries to persons responsible.	0						
4.6.0	DEMONSTRATES KNOWLEDGE OF THE RELATIONSHIPS OF SCIENCE TO OTHER AREAS OF HUMAN ENDEAVOR.							
4.6.1	Identifies how modern techniques of determining the age of specimens contribute to knowledge of earlier civilizations.							
4.7.0	DEMONSTRATES KNOWLEDGE OF WAYS IN WHICH ATTITUDES, THINKING PROCESSES, AND SKILLS CAN BE RELATED FOR USE IN PERSONAL DECISION-MAKING.							
4.7.1	Given a list of foods, identifies items that would constitute a nutritious, balanced meal.	0		•		•		
4.7.2	Given manufacturers' literature and consumer research data, selects an object on the basis of comparison of various factors.					•		
4.7.3	Uses data from scientific investigations in presenting a position on a political issue.							
4.8.0	DEMONSTRATES GENERAL KNOWLEDGE OF SCIENCE.							
4.8.1	Recognizes that a cell is the basic unit of structure and function of a living organism.	0		•		•		
4.8.2	Recognizes that all living organisms have the same life processes.	0		•		•		
4.8.3	Demonstrates a basic knowledge of the structures and functions of the human organism.	0		•		•		
4.8.4	Understands and describes living organisms that grow and develop in different environments.	0		•		•		
4.8.5	Recognizes that the sun is the source of energy for green plants and is basic to the growth and maintenance of living organisms.	0		•		•		

KNOWLEDGE (CONT.)

		K-6	7	8	9	10	11	12
4.8.6	Recognizes the importance of energy levels as related to ecosystems.							
4.8.7	Recognizes that living organisms utilize matter and return it to the environment.	0						
4.8.8	Describes examples of humankind's dependence on and interference with natural ecosystems.	0		•		•		
4.8.9	Recognizes that a living organism is a product of its heredity and environment.	0		•		•		
4.8.10	Recognizes that all forms of life are composed of the same elements in different DNA blueprints.							
4.8.11	Understands relationships of structure and function of living organisms to their environment.					•		
4.8.12	Recognizes that living organisms have changed over the ages and that some species are now extinct.	0		•		•		
4.8.13	Recognizes that the motion and path of celestial bodies are predictable.	0		•		•		
4.8.14	Describes the regular movements of the earth and moon.	0		•		•		
4.8.15	Demonstrates an appreciation and understanding of time/space relationships.	0						
4.8.16	Demonstrates knowledge of basic differences between planets, stars, the solar system, the Milky Way Galaxy, and the known universe.	0		•		•		
4.8.17	Cites some of the accomplishments in humankind's exploration of space.	0		•		•		
4.8.18	Demonstrates knowledge of the effects of moon and sun on ocean tides.	0						
4.8.19	Recognizes that matter exists as solids, liquids, and gases.	0		•		•		
4.8.20	Demonstrates that in chemical or physical changes the total amount of matter remains unchanged.	0		•		•		
4.8.21	Recognizes that in nuclear reactions a loss of matter is a gain in energy, the sum of matter and energy remains constant.							

KNOWLEDGE (CONT.)

		K-6	7	8	9	10	11	12
4.8.22	Recognizes that there are continuous changes on earth.	○——	——	●——	——	●——	——	——
4.8.23	Recognizes that rocks contain one or more kinds of minerals.	○——	——	——	——	——	——	——
4.8.24	Recognizes the three major types of rocks that make up the earth.	- - - -	- - - -	——	——	——	——	——
4.8.25	Recognizes the value of using renewable energy sources instead of non-renewable sources.	○——	——	●——	——	●——	——	——
4.8.26	Identifies major factors that cause weather changes and patterns.	- - - -	- - - -	——	——	——	——	——
4.8.27	Identifies the effect of weather on the local environment.	○——	——	●——	——	●——	——	——
4.8.28	Identifies the ocean as a major influence on weather.	○——	——	●——	——	●——	——	——
4.8.29	Recognizes simple machines and their functions.	○——	——	——	——	——	——	——
4.8.30	Understands the definitions and interrelationships of force, work, and energy.			——	——	——	——	——